UNIVERSITY OF KWAZULU-NATAL

FACTORS INFLUENCING THE ADOPTION OF EXTERNAL WEB API'S: AN EXAMINATION OF THE UPTAKE OF EXTERNAL WEB API'S BY ABSA BANK (A CASE STUDY OF ABSA BANK SOUTH AFRICA)

By

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<u>Acknowledgements</u>

Abstract

Factors Influencing the Adoption of External Web API's: An Examination of the Uptake of External Web API's by Absa Bank (A Case study of Absa Bank South Africa)

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Web Application Programming Interfaces (APIs) are enablers for many future technology concepts that enable interoperability and platform independence (such as the concepts of "open data" and "open Banking" and strategies such as Service Oriented Enterprise Architecture (SOEA)). Some of these concepts have been in existence for over a decade but the increase in the adoption of external Web API's has become the driving force behind the growth and acceptance of the concepts of interoperability and compatibility of technology in the Banking industry. The ultimate beneficiary of this objective to enable open collaboration between technologies in the Banking sector, is the customer. The significance of external Web APIs cannot be emphasized enough for businesses that seek to remain relevant and competitive through digital strategies. However, information systems literature on the adoption of external Web APIs by financial institutions bears testimony to a low rate of adoption. In order to address this situation, the primary objective of the current study is to establish reasons for the low rate of adoption of external Web APIs in a South African context.

A case study approach is adopted so that an in-depth analysis of issues underpinning the adoption of external Web APIs can be ascertained. Absa Bank of South Africa is used to conduct the study. The choice of Absa Bank as the focus of the case study is one of convenience and purposiveness. From a convenience perspective, the researcher's engagement with external Web API technology as an employee of Absa Bank provided an opportunity for in-depth, meaningful interaction with crucial components of the

technology. From a purposive perspective, Absa Bank have made a commitment to the use of external Web APIs in order to enable collaboration with its Banking partners.

A mixed methods approach is adopted for the study. The conceptual framework adopted for the study is centred on Roger's Diffusion of Innovation (DOI) theory and the additional constructs of trust and security, both of which are pivotal to technology related influences in the Banking sector. The study's corpus data is collected through interviews and questionnaires in order to answer the following main research questions:

- What is the influence of the attributes of external Web APIs on the level of adoption at Absa Bank?
- What is the influence of perceived trust of external Web APIs on the level of adoption at Absa Bank?
- What is the influence of perceived security of external Web APIs on the level of adoption at Absa Bank?

The first research question alludes to the attributes of a technology based intervention that influences the adoption of that intervention as propped in Rogers (2010) Diffusion of Innovation theory.

A significant outcome of the study is that the DOI attributes have a positive influence on the adoption of external Web APIs. However, the technology itself needs to be adjusted to accommodate concerns of security and trust in order to enhance its adoption in the Banking sector.

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LIST OF ABBREVIATIONS

API	Application Programming Interface
HTTP	Hypertext Transfer Protocol
IS	Information Systems
IT	Information Technology
JSON	JavaScript Object Notation
REST	Representational State Transfer
RPC	Remote Procedure Call
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
TAM	Technology Acceptance Model
TRA	Theory of Reasoned Action
URI	Uniform Resource Identifier
UTAUT	Unified Theory of Acceptance and use of Technology
WADL	Web Application Description Language
WSDL	Web Service Description Language
XML	eXtensible Markup Language

CHAPTER 1.0   INTRODUCTION

1.1   Introduction

The global financial industry has begun to realize and harness the value of data to extract utility across different business arears (Srivastava & Gopalkrishnan, 2015). Since Banks mainly rely on customer data; more accurate data about customers is of importance. Data analytics is a common concept in Banking yet they often lack a complete view of a customer; since customer data is usually spread across different departments and platforms within a Bank and different Banks. Incomplete view of the customer may prevent Banks from building perfect services and products that are customer centric.

Achieving Open data in Banking will provide an opportunity for Banks to have a complete insight of a customer. Open data in other areas like the public sector has made information more accessible although different formats of information can make consumption and utilization difficult (O'Riain, Curry, & Harth, 2012).According to Arroqui, Mateos, Machado, and Zunino (2012) the Representational State Transfer (REST) service is the most appropriate mechanism that can be used to access information of different formats from the network.

The degree of API openness determines its potential reach. When API's are classified by level of openness they are named 'Closed APIs', 'Private APIs', and 'Open APIs'. 'Open' does not necessary mean that the bank's system is accessible to everyone. External access need to be consistently controlled by the Bank in order to preserve security, privacy and contractual conditions. Organizations classify APIs as External and Internal/ Local, this classification is based on user access which can be within or outside the boundaries of the organization (Vita, 2004). The Web APIs are built upon globally accepted technical standards. This research paper focuses on certain external API technical key concepts such as data transmission, data exchange, data access and API design; although for the financial

industry where funds and sensitive customer data are involved, other aspects of API's need serious consideration. These include legal, operational and functional, to name a few.

The role of external Web APIs in Banking enable services to be built using the Bank's products and services data, customer data and data about Bank transactions that the Bank's customers may choose to share themselves through the Bank and third partys' secure and controlled means. Through external open RESTful Web APIs, data can be made available as Open data so that a variety of services and products that require historical figures and real time data, such as comparison tools can be built, allowing customers to get more insight into their Banking relationships. External Web APIs/ Services, as a company interface, allows the outside world to innovate and find more applications of the services, products, and data of a company.

This study investigates the adoption of external Web APIs by Absa Bank South Africa as the enabling technology for Open data, Open Banking and Service Oriented Architecture (SOA). This research paper will apply Rogers' diffusion of innovation theory to investigate the relationship between perceived characteristics of external Web APIs/ Services and external Web APIs adoption. Rogers's diffusion of innovation model provides a useful perspective on technological innovation adoption (Kaminski, 2011). The model can be used as a change model to guide the technological innovations that ought to be presented in a way that is aligned with the existing values and needs of the organization or users thus increasing the innovation chances and rate of adoption (Robinson, 2009). The focus will extend to the perceived trust, security & privacy when using Web services and the perceived characteristics of innovation that Rogers (2010) claims has a major impact on the diffusion rate of an innovation.

1.2   Background to the Study

Fielding (2000) introduced the Representational State Transfer (REST) architecture, which can be defined as a set of design criteria through which one can design Web APIs/ services that focus on application resources with regards to how to address and transfer

representation of resource over Hypertext Transfer Protocol (HTTP), (Rodriguez, 2008). The Simple Object Access Protocol (SOAP) was designed for Microsoft as an object access protocol, and is used to exchange structured information over the network Suda (2003). Web APIs/ Services are APIs wrapped in HTTP. An Application Programming Interface (API) enables companies to efficiently expose data and functionality to third parties in a secure, controlled, and cost effective manner (Feng, Shen, & Fan, 2009). There is a visible increase in the number of organizations that implement their Web services using REST (Adamczyk, Smith, Johnson, & Hafiz, 2011).

The origin of Web APIs/ Services can be traced back to distributed systems (Mumbaikar & Padiya, 2013). Web services can be defined as "self-contained, self-describing, modular applications that can be published, located, and invoked across the Web" (Wang, Huang, Qu, & Xie, 2004). Various definitions make it clear that a web service should be compliant to public internet standards (Bora & Bezboruah, 2015; K. Lee, 2015; Mumbaikar & Padiya, 2013). Distributed systems are based on the traditional object-oriented systems which distribute the object over the network in order to allow reuse (Mumbaikar & Padiya, 2013).

The rapidly evolving digital eco-system is changing the way customers consume information and services. The changes in customer needs as well as expectations require a more focused approach of delivering connected customer experience where by companies with heavy digital presence are adopting Web services. A study by Adamczyk et al. (2011) shows that in the year 2006, 12% of enterprises reported completing a "full enterprise roll-out" of Web services and 21% were in the process of doing so. According to Laskey and Laskey (2009) in 2006 the global spend on service oriented applications was nearly 2 billion dollars, and it was expected to rise to approximately 14 billion by 2014. Even though

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the estimated 14 billion spent by2014 cannot be substantiated, the rapid growth in public

APIs between 2009 and 2014 suggest a possibility of this estimate to be true.
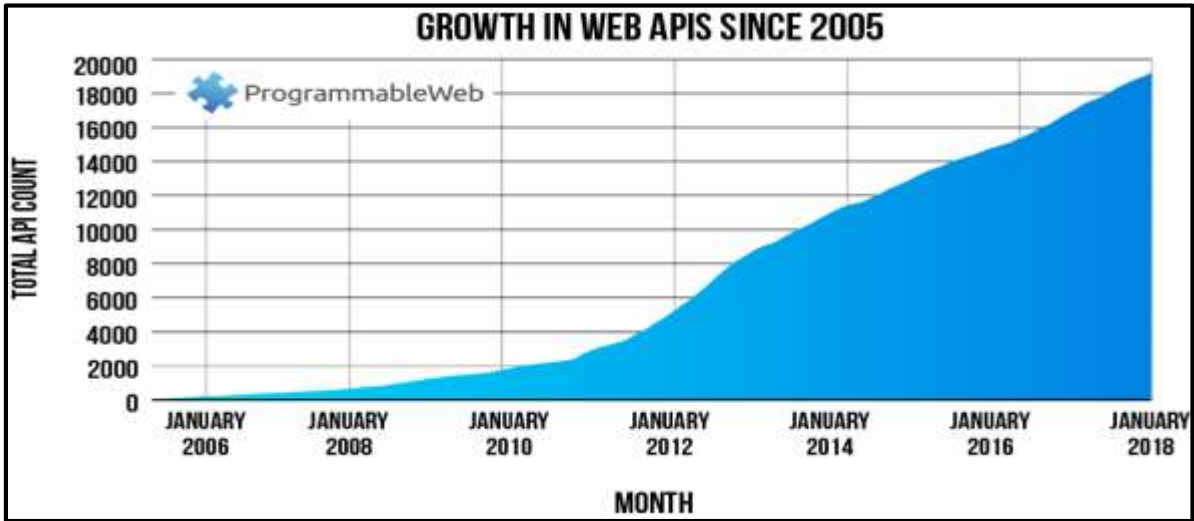
Figure 1: Growth in Web APIs since 2005

Table 1: Web APIs Added Since 2014

Web APIs Added Since 2014	
Total new APIs added since 2014	8,240
Average new APIs added yearly	2,060
Average new APIs added monthly	172

The programmable web reported an increase in global public/ external Web APIs (see

Figure 1). The programmable web is among the wold's leading public APIs directory and

regularly reporters on API economy. The programmable web graph below illustrates the

most represented public APIs on their API's directory. According to Figure 2 below the

financial category has seen a growing interest around APIs but it is empirical to note that

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the Banking sector is not well represented in this Financial API category. The most public APIs in this category are from Fintechs and other private held financial software companies such as Bloomberg, PayPal and Visa. Figure 2 shows financial industry growing interest around external APIs but Table 2 reveals the actual numbers and a slow growth is noted if compared with Table 1 which represents the overall growth since 2014.
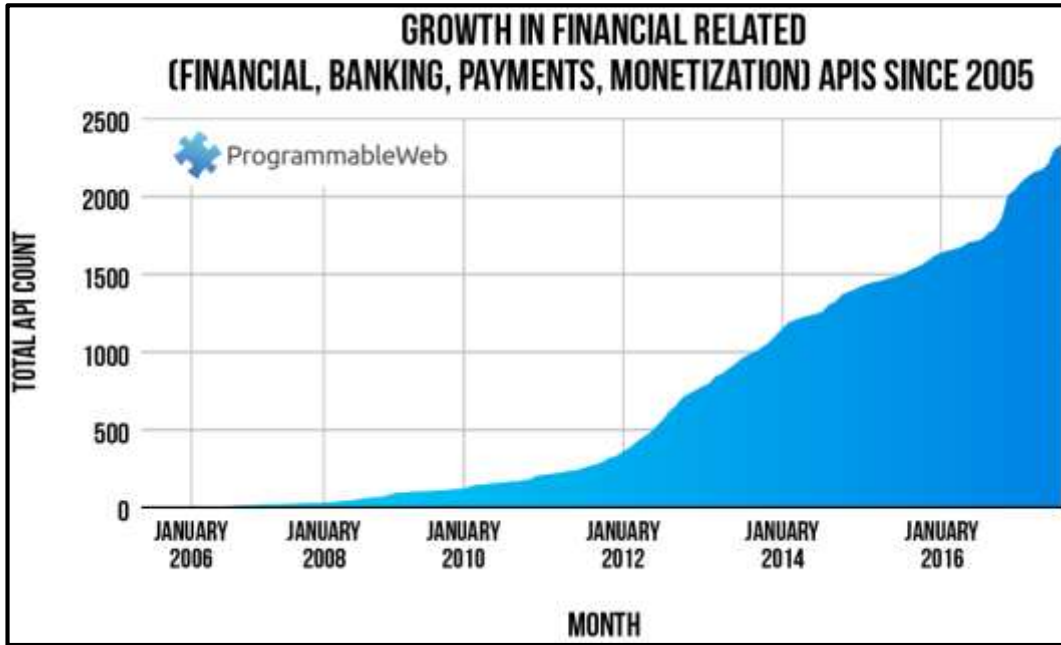
Figure 2: API Growth in Financial Industry since 2005

Table 2: Financial APIs Added since 2014

Year	APIs Added (Financial, Monetization, Payments, Banking)
2014	298
2015	216

Year	APIs Added (Financial, Monetization, Payments, Banking)
2016	424
2017 (through June)	261

In 2008 CIO Insight revealed that '79% of executives expect their company's technology architecture to be based on service-oriented architecture (SOA) in five years (Maurizio, Sager, Corbitt, & Girolami, 2008). The increasing adoption of Web APIs has become a major contributor for SOA. The rationale behind SOA is that multiple micro services are made visible to potential users outside organization's domain (Maurizio et al., 2008).

The architecture framework of Web APIs is an international standard. Companies are therefore taking the opportunity to invest in systems based on this architecture in order to support their business processes. The above Figure 1 shows a general increase in the use of external APIs but the Banking sector still remains sceptical about using external Web APIs as demonstrated in Figure 2 which contributes only a small fraction of the increased numbers in Figure 1.

The 2017/ 2018 KPMG banking systems survey shows an increase in IT resource's investment by banks ("banking systems survey", 2018). Absa Bank South Africa together with the other three big Banks in South Africa reported a continuous increase in IT related spending to over R30 billion in a period of 12 months in 2016 ("'Big Four' IT spending tops R30 billion a year", 2018). The Accenture open for business report states that banks are spending more resources on technology with the objective to provide customer-centric products ("Open for business", 2018).

The Absa Bank has commenced a technological transformation in Service Oriented architecture. The micro services together with other concepts that will be enabled by Web APIs have the potential to stimulate innovation in the Banking industry. The adoption of external Web APIs in Banking has potential to escalate the adoption of Open Banking, Service Oriented Architecture, and Open data and to help the Banking intuitions to explore several ways in which customer data could be used to assist customers to efficiently and effectively transact, borrow, lend, save, and invest.

The value of external Web APIs is not only for the benefit of the business but also the customer and business partners (Adamczyk et al., 2011). The Accenture open for business report states that if banks fail to address open banking (external Web APIs) they are at risk to fail to meet consumer's demands("Open for business", 2018).

1.3   Research Problem

The Banking industry reflects readiness to utilize Web APIs, particularly external Web APIs in order to assist in meeting customer needs and expectations and also to share data across multiple platforms of the new digital eco-system (Wagh & Thool, 2012). Despite the proliferation of Web APIs since 2005 as reported by different API's directories the banking industry has only seen a slow increase of external Web APIs. The visible business and technical benefits associated with the adoption of external Web APIs such as expanding customer base, revenue increase, improved productivity, engaging; and connected customer experience set an urgent need to study and acquire insight as to why banking industry is falling behind on the adoption (Adamczyk et al., 2011).

Research through the use of surveys illustrates that the majority of Web APIs initiatives by Banking institutes are within the company firewalls (("Open for business", 2018), ("banking systems survey", 2018)). A Survey by Vita (2004) illustrates that the majority of Web APIs pertaining to banking institutions are designed for one-way flow, rather than for the distribution of information enabled by an automated exchange of services through external Web APIs. Vita (2004) argues that Web APIs in the banking industry will continue

to be local and with a limited adoption until barriers such as security and privacy are addressed accordingly. In the interim, local/closed APIs serve as a barrier against innovation and collaboration between the banking industry and financial technology companies.

1.4 Research Questions

The main research question is as follows:

How and to what extent is the level of adoption of external Web APIs at Absa Bank influenced by its perceived attributes?

The study will use data collected through interviews and questionnaires to answer the following research questions derived from the study main question:

1. What is the influence of relative advantage, observability, complexity, compatibility and trialability attributes of external Web APIs on the level of adoption at Absa Bank?

2. What is the influence of software practitioners' perceived trust of external Web APIs on the level of adoption at Absa Bank?

3. What is the influence of perceived security of external Web APIs on the level of adoption at Absa Bank?

1.5 Research Objectives

This study's main objective is to determine the influence that the attributes of external Web APIs have on software development practitioners' intention to implement external Web APIs for general software development at Absa Bank. These objectives are stated below for clarity:

1. To determine the influence of the **attributes** of external Web APIs on the willingness of software practitioners' at Absa Bank to adopt external Web APIs.

2. To determine the influence of **perceived trust** of external Web APIs on the willingness of software practitioners' at Absa Bank to adopt external Web APIs.

3. To determine the influence of **perceived security and privacy** of external Web APIs on the willingness of software practitioners' at Absa Bank to adopt external Web APIs.

1.6   Research Hypotheses

The study has adopted a mixed methods approach. However, Roger's Diffusion of Innovation (DOI) theory is used to operationalise one of the main variables in the quantitative component of the study. In order to ascertain the attributes of external Web APIs that influence its adoption, the 5 constructs found in the DOI theory is used. These are: relative advantage, observability, complexity, compatibility and trialability.

According to Zhang, Yu, Yan, and Spil (2015) the DOI theory is one of the most popular and utilized theories when studying the adoption of information technologies. The decision to adopt the DOI theory as an underlying theoretical model may be attributed to the observation by Robinson (2009) and (Kaminski, 2011) that if an innovation has a greater perceived relative advantage, is not terribly complex to use and is compatible with existing technology, it is likely to have a rapid adoption. Roger's reference to these constructs in the DOI is what makes this theory a viable choice as a mechanism of operationalising a user's intention to adopt the new technology. The first research question makes reference to the attributes of external Web APIs. In order to operationalise the influence of these attributes, the constructs of DOI have been used to develop hypotheses to establish this aspect of adoption. These hypotheses are listed below:

The null hypotheses are designated by H_N and alternative hypotheses by H_A.

1. *Relative advantage*

   H_N1**:** There is no relationship between the perceived relative advantage of external Web APIs and its adoption.

   H_A1**:** There is a relationship between the perceived relative advantage of external Web APIs and its adoption.

2. *Compatibility*

   H_N2**:** There is no relationship between the perceived compatibility of external Web APIs and its adoption.

   H_A2**:** There is a relationship between the perceived compatibility of external Web APIs and its adoption.

3. *Complexity*

   H_N3**:** There is no relationship between the perceived complexity of external Web APIs and its adoption.

   H_A3**:** There is a relationship between the perceived complexity of external Web APIs and its adoption.

4. *Trialability*

   H_N4**:** There is no relationship between the perceived trialability of external Web APIs and its adoption.

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H$_A$4**:** There is a relationship between the perceived trialability of external Web APIs and its adoption.

5. *Observability*

H$_N$5**:** There is no relationship between the perceived observability of external Web APIs and its adoption.

H$_A$5**:** There is a relationship between the perceived observability of external Web APIs and its adoption.

Two additional hypotheses were added to cover the aspects of adoption that may be influenced by security and trust. In the Banking sector, these two issues play a pivotal role in the adoption of technology. The two hypotheses that are added are further contextualised in the conceptual framework that underpins the study (covered in Chapter 3).

6. *Security*

H$_N$6**:** There is no relationship between the security inherent in the use of an external Web API and its adoption.

H$_A$6**:** There is a relationship between the security inherent in the use of an external Web API and its adoption.

7. *Trust*

H$_N$7**:** There is no relationship between the security inherent in the use of an external Web API and its adoption.

H$_A$7**:** There is a relationship between perceived trust of external Web APIs and its adoption.

1.7   Significance/Importance/Contribution of the Study

The study uses Rogers (2010) characteristics of innovation to examine the adoption of external Web APIs. The additional attributes of trust and perceived security are used to supplement Roger's DOI theory so that it has a higher level of applicability to the Banking sector. Hence, the study makes a contribution from an academic perspective by enhancing Rogers' DOI theoretical model for applicability to the Banking context. The study also serves a practical purpose by proposing a set of best practices for the implementation an external web API in a Banking setting. This kind of intervention enhances the viability of future use of external Web APIs so that the Banking sector can leverage off a richer suite of functionality that will be ultimately accessible to its customers.

The proposed best practices of external Web API implementation are intended to guide, support, escalate and improve the likelihood of Web APIs being adopted. Furthermore, the study will outline the relationship if there is any, between perceived characteristics of external Web APIs, perceived security, the Trust and willingness to adopt external Web APIs with the aim of assisting technology leaders in Banking industry to respond accordingly to these attributes and position external Web APIs in a more effective way to ensure that they are appealing to the users.

1.8   Justification for the Study

The adoption of external Web APIs in Banking has the potential to escalate the adoption of Open Banking, Service Oriented Architecture, and Open data and to help the Banking intuitions to explore several ways in which customer data could be used to help customers efficiently and effectively transact, borrow, lend, save and invest. The literature shows a limited number of research on the effects of the perceived attributes of innovation on the rate of adoption. According to Rogers (2010) Diffusion of Innovation Theory to accelerate the adoption technology characteristics must be examined in order to adjust them to be in line with the values and beliefs of the users.

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CHAPTER 2.0   LITERATURE REVIEW

2.1   Introduction

The academic literature review of this research project is based on the key technical concepts (Data Transmission, Data Exchange, Data Access, and API Design) of web API/ services that are aligned with the Rogers five innovation attributes that impact its rate of adoption. The review discusses two Web API/ services architecture; REST and RPC-style architecture, with reference to RESTful Web APIs/ Services   and SOAP based services which follow the RPC-style. The review also covers web service technologies.

The external Web APIs/ Services as an enabler for Open Banking, Open data, and SOA comprises of four key technical concept that will be reviewed in this chapter. According to Vita (2004) Banking Web APIs that involve sharing of confidential, personal, and transactional data need attention beyond the technical aspects. Technical concepts of Web APIs include data transmission, data exchange, data access, and web API design (Newcomer & Lomow, 2005). As they operate in a strictly regulated environment the banking industry has a need to apply controls and standardization beyond technology standards whenever creating technology infrastructure for internal or external use (Vita, 2004).   Dimensions of standardization by the banking industry, include operational standards, legal agreements, and functional agreements. In this context, external Web API agreements should be based on running Web APIs after implementation in a secure, effective and efficient manner that promotes trust.

Application Programming Interfaces (APIs) consists of classes with properties and methods that are integrated with a reusable component that interacts with other applications (Lakshmiraghavan, 2013). APIs enable third party access to the organizations' data and processes, locally or over the network. APIs in the context of web development can be defined as a set of Hypertext Transfer Protocol (HTTP) requests and response messages from a client to server and back to the client, which are mostly in a form of Extensible

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Markup Language (XML) or JavaScript Object Notation (JSON). Lakshmiraghavan (2013) suggest that APIs are business processes or capabilities of a bank that are exposed externally with the intent of sharing the customers' and bank's products and services in a secure way, thus creating an Open Banking environment.

2.2   Web API Design

The common standardized design principles for Web APIs / Services are based on RPC-style and REST architectures. The 'REST like services' uses the client node to send requests to the server and gets a response – (client/ server style). In these services no nodes of the network keep track of the preceding communication state (Andry, Wan, & Nicholson, 2011). In terms of the REST style the communication is based on a transfer of representation of resources (Kalali & Mehta, 2013). The resources are functions or services identified by the Uniform Resource Identifier (URI) as illustrated in Figure 3 below.

Figure 3: URI Example

The resource's representation is captured on a document which reflects its intended state which contains any useful information about the resource (Mumbaikar & Padiya, 2013). The *'REST like service'* state has two meanings i.e. resource state which stays on the server side and application state which exist on the client side and it reflects the path followed by the client through the application (Feng et al., 2009). The 'REST like service' is illustrated in Figure 4.

Figure 4: REST Service Example

SOAP Web API

The *'SOAP like services'* can be referred to as an XML Web specification (Mumbaikar & Padiya, 2013). The SOAP services are used to exchange information between applications that could be running on different operating systems, with different technologies and programing languages (Richardson & Ruby, 2008). SOAP service were labelled as a lightweight protocol when it replaced object oriented technologies. SOAP uses the power of XML and the internet to exchange information between nodes in a decentralized or distributed environment. SOAP principles are known for their vital role in facilitating the actual sending of messages in Web service. Web services are APIs that are wrapped in 'HTTP' protocol. SOAP services enable companies to share resources or capabilities internally and externally with customers and partners (Wagh & Thool, 2012). The SOAP

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service's ability to effectively and efficiently share information with customers and business partners over the network is vital for the competitiveness of a company.

Goncalves (2013) argues that SOAP Web services became a popular middleware, especially when integrating with legacy systems, because of its divertive nature, as mentioned before SOAP can function with any programing language on any computing environment. However *'SOAP like services'* has its pros and cons. ensuring that SOAP based services are more flexible and extensible and requires trade-offs ("SOAP Web services", 2003). Looking closely at the building blocks of SOAP such as XML, the advantages and disadvantages of SOAP become apparent. XML is given greater coverage in Section 2.3. The focus on XML is warranted because the benefits and limitations of SOAP are made quite clear when the inner workings of XML is examined.

The platform and transport independent characteristics of SOAP smoothen the process of making remote protocol calls (RPC) to the server. However, if SOAP is linked to one platform it would be difficult to make such calls since prior knowledge of the server will be required. RPC uses method name and parameters to generate XML structure. According to Suda (2003) SOAP's ability to be transported over any transport protocol (HTTP, SMTP) ensures that the future of SOAP messaging is secure even if the internet protocols had to change, SOAP will be able to adapt. SOAP's platforms and operating systems independency allows companies to connect with legacy systems and pull out data to other applications as SOAP messages. SOAP messages are sent in Plain Text Packets which is basically plain text with a special header.

SOAP message Version 1.1

Content-Type: application/soap+_xml: action="http://example.com"

SOAP message Version 1.2

Content- Type: text/xml SOAP action: "http://example.com"

(Suda, 2003).

The SOAP service changes from version 1.1 to version 1.2 allowed for transparency such that firewalls and packet sniffers can go through the messages and be able to validate them. Previous distributed technologies such as CORBA did not allow for such transparency. The transparency of SOAP messages in version 1.2 is a recognizable strength of RPC style.

RESTful Services

The REST architecture provides an alternative to RPC-style (RESTful Web APIs/ Services) that avoids most of the SOAP based Web services setbacks. REST use an HTTP request to share resources between a client and a server. HTTP requests can be used to post, read, and delete data. REST architecture relies on resources, state of a resource and state of a network node and representation of a resource.

The Fielding (2000) REST architectural constraints emphasize good qualities of scalable Web services. The good qualities of scalable services include interfaces which are generic and the ability to deploy service components independently (Feng et al., 2009). Although REST is presented as a strong alternative Web API design, it has some shortcomings such as its inability to encode large amounts of input data in the resource URI since the server might refuse the request and it sometimes crashes (Albreshne, Fuhrer, & Pasquier, 2009). According to Fielding (2000), the client-server interaction should be stateless and the client request should be complete, which means a request should contain enough information for the server to understand what is required and how it ought to execute the request. The HTTP functions such as GET, DELETE, PUT, HEAD, and POST facilitate request execution and the understanding between client and server. Session state is stored on the client side. The Cache constraints dictate that response data should be implicitly or explicitly labelled as cacheable or not. If it is cacheable, a client is given the right to reuse data for a similar request at a later stage thus eliminating redundancy and improving performance.

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Prior to the comparison between REST (RESTful based Web APIs) and SOAP based Web services, it is important to draw a distinction between the two API's design. Adamczyk et al. (2011) suggest that differentiation is critical for the development of enterprise systems. REST is an architectural style while SOAP is a protocol. REST is a style for designing Web APIs/services with a low degree of coupling (Stowe, 2015). The degree of coupling between a SOAP client and the server is slightly higher. REST architectural style relies on HTTP functions for messaging while SOAP uses XML capabilities (Wagh & Thool, 2012).

The Summary of REST, and RPC-style architecture

Feng et al. (2009) conducted a comparative analysis between REST and RPC-style architecture based on certain properties that are perceived to be the keys to the success of the Web i.e. performance, coupling, scalability, addressability, and connectedness.

- The SOAP uses WSDL as a standard vocabulary to describe the web service interface, while REST currently has no such grammar (Albreshne et al., 2009). REST based services require both service consumer and service producer to have an out-of-band agreement. WADL, a machine-readable language can be used to describe REST based services.
- REST based services have no built-in security features like encryption and session management. REST based services can be used on top of HTTPS or security features can be added on HTTP.
- RESTful services are more flexible than SOAP and Web API/services literature seems to resonate with the afore-mentioned claim. A crucial observation that lends credence to this argument is that SOAP only supports XML for sending messages while REST supports different formats.
- REST based services consume less bandwidth as the message size is smaller which improves performance when compared with SOAP. According to Amazon, REST based Web APIs run six times faster.

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Bloch (2006), the chief software engineer at Google Corporation, states that Web APIs can be the most valuable asset of an organization but they can also be a great liability. Web APIs with good design can capture the customer's attention. However, poorly designed APIs become a liability as more time and effort will be required for customer support. According to Mulloy (2013) the success of the API design is measured by how fast the developers utilizing your API can get up to speed and develop successfully using your API. The practitioners in software engineering agree on the main characteristics of a good API. The main attributes that provided a basis for an overwhelming endorsement of Web APIs is that it is easy to use, easy to understand and easy to expand, to name a few.

Which style is best, RESTful Web API/ Services or SOAP?

The question of which architecture is most suitable for Web APIs is controversial. Information systems converge to the conclusion that REST is the most applicable Web service architecture. There are however, a few instances where SOAP has been claimed to achieve a better outcome; for instance in Business to Business scenarios and within the enterprise (Wagh & Thool, 2012). According to the literature on Web API's, REST based service should be used when developing services which support different protocols. Although SOAP may be a preferable choice when developing complex highly secured APIs; for lightweight APIs that support CRUID (create, read, update, insert and delete), REST based Web API is the better choice.

2.3   Data Exchange

The Web APIs facilitate the communication between the nodes of a network. The main objective is to facilitate the sharing of resources over the network. Resources could be raw data, files, etc. XML and JSON are regarded as the most commonly used data exchange formats for Web APIs/services. Although the XML format has been in existence longer and has slightly more functionality than JSON, JSON is currently the most commonly used format (Smith, 2015).

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eXtensible Markup Language (XML) and JavaScript Object Notation (JSON)

The XML format is readable to both humans and machines and it is application independent that consists of a text based syntax that forms the basis for most modern Web APIs (Fawcett, Ayers, & Quin, 2012). XML is a subset of Standard Generalized Markup Language (SGML) a standard for encoding paper documents into electronic format ("A brief SGML tutorial", 2017). The XML format stores and transports data though its content and structure. The structural arrangement of XML adds an unnecessary layer of complexity thereby limiting its domain of usage. JSON however comprises of a much simpler structure thereby making it an ideal choice for data transfer (Fawcett et al., 2012).

JSON is grammatically simpler and it is easier to implement. These features render JSON as a better data transfer format than SOAP (Kalali & Mehta, 2013). JSON is not a programing language but a data format which is a subset of a highly recognized and growing language in internet technologies *'JavaScript'*. JSON is officially recognized as an ECMA standard and is also subjected to the rules defined by ECMA-262. JSON is an alternative to the XML format. The ECMA-404 standard stipulates that JSON data structure can only be represented as either an array or object (Smith, 2015).

Although JSON contains similar features to the *'JavaScript'* language it is still a data interchange standard that is very useful wherever data exchange is required between a browser and a server or server to server (Smith, 2015). The main objective of Web APIs is to facilitate information exchange between applications in a standard form and the most appropriate format is JSON (Mumbaikar & Padiya, 2013).

2.4   Data Transmission

The SOAP protocol specification exchanges data in Web APIs/services over a network. The SOAP service uses XML as a format for sending and receiving massages and wraps them with Hypertext Transfer Protocol (HTTP) which is a network transport protocol. The REST based services also uses HTTP protocol for transporting massages between network

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nodes and the exchange of data in REST is simpler than SOAP. The response files in REST are readily usable while SOAP massages are wrapped in a SOAP that necessitates the use of the XML standard. REST does not need to use XML format. A request to a RESTful Web API places the method information in the HTTP method while SOAP like Web services usually ignores the HTTP method. The SOAP based services (RPC-style) places the resource information in the URL, HTTP headers or an entity-body (Richardson & Ruby, 2008).

According to Albreshne et al. (2009) HTTP and REST based services share similar attributes. HTTP technology is common for all Web services and is supported by all internet browsers and servers. The aforementioned attributes of HTTP allows Web APIs to communicate between applications of different technologies. According to Lee (2015), HTTP is a document-based protocol. The HTTP use strict standards to transport documents between client and server. The standardization of HTTP operations/ methods is a great advantage for REST (Lee, 2015). The HTTP functions ensure that the client server communication are clear and concise. The HTTP functions let the server know exactly what to do with the request. The common HTTP operations for RESTful services are create or update to post data, read data to make queries and delete data.

2.5   Data Access

The field of professional software development is reported to be in favour of REST based architecture for Web services due to their lightweight nature. The preference for the REST architecture raises a need to ensure that there is adequate security on the network so as to secure the Web APIs from various forms of network attacks. According to Albreshne et al. (2009) developers have neglected the security part of Web APIs, even though external RESTful Web APIs provide access to the organizations' data and internal resources to the outside world. According to Bozkurt, Harman, and Hassoun (2010) security concerns are slowing down the adoption of Web APIs. .

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The concept of information security is a reference to the protection of information and information systems from unauthorized access, use, disclosure, disruption, modification, or destruction to provide the elements of the confidentiality, integrity and availability (Lakshmiraghavan, 2013). Information security is a major barrier to the adoption Web APIs and overall online Banking activities and the growth of e-commerce (Roca et al., 2009; Vita, 2004). According to Udo (2001) users need to feel secure when using technological innovations on a network. Information system's security involves the use of technical and non-technical solutions to mitigate or prevent risks. According to Roca et al., security has a positive influence on the use of banking technological innovations over the internet and piracy of information where data is used for more than its intended purpose is a huge deterrent to the adoption of online banking. According to Chellappa and Pavlou (2002) customers are not comfortable with using banking technological innovations over the internet as they are concerned with possible interception of their information and misuse. Systems security invasions results in increased negative perceptions from customers, especially with regards to internet transactions

The SOAP Web APIs technology does not have any security features except for sending data via the HTTPS protocol which only protects data on the network layer, but this can also work against SOAP (Mumbaikar & Padiya, 2013). Since SOAP message packages are wrapped into HTTP envelopes and use the POST HTTP method to transfer the package such SOAP messages can easily go through a firewall by navigating through port 80. This method attracts security risks, as SOAP messages can carry malicious requests past the firewall. The server can only understand SOAP messages after they have been parsed. A firewall requires additional protocols to help detect or block malicious SOAP messages (Bora & Bezboruah, 2015).

As previously mentioned, SOAP messages comprise of plain with little structure. The header section of the SOAP message envelope is commonly used to incorporate authentication data. The nature of SOAP messages (plain text) does not guarantee that the data is secure (SOAP Web services 2003). The World Wide Web Consortium (WWWC)

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organization is currently reviewing Web API's security specifications for the Advancement of Structured Information Standards to address the SOAP security shortfalls.

The REST architecture has an immature security framework which is a root of the gap between current web security and RESTful web service's security (Forsberg, 2009). According to Feng et al. (2009) the REST security model is simpler and more effective when compared to the RPC-style. Although there is no standard defined security framework for RESTful Web services (Lakshmiraghavan, 2013), the Fielding (2000) REST style constraints can be used to define effective security policies to protect resources.

By default, the RESTful Web APIs is abstracted into the resource and all resources are identified through unique URL's (Forsberg, 2009). According to Fielding (2000) the Restful Web API makes it easier to hide resources by not releasing a resource URL. The HTTP functions can make up different security policies, for instance if a resource is read only then only GET is exposed to the client and same for POST, PUT, and DELETE operations. The self-describing HTTP functions can help to set up different permissions for operations of a resource on the HTTP firewall (Forsberg, 2009).

2.6   Other Web APIs/ Services Technologies

The HTTP technology is common for all Web services but not all Web APIs use this protocol. HTTP is a document-based protocol (Richardson & Ruby, 2007). HTTP transport client-server messages (SOAP documents) using strict standards. The Client and server nodes exchange requests and responses using the HTTP envelope which contains HTTP standardized operations. (Richardson & Ruby, 2007).

Web Service Description Language (WSDL) and Web Application Description Language (WADL): Documentation

The API specification defines the overall behaviour of the services provided by the API. The specification describes how the Web API links with the other applications in and out of the organization's domain. The API specification can be used to derive a documentation

of the services enclosed within the API. The documentation illustrates how developers can make use of the functions of the API. A good documentation considers both functional and technical understanding of the services. The functional understanding of the service aim to remove all abstractions; thus providing a meaningful and clear understating of the API.

The complexity of Web APIs requires a standardized way of expressing all the different types of services. Web services can always be described through well-written documentation entailing implementation and a binding procedure. The WSDL document makes it possible to invoke JUST-In-Time services. The WSDL XML document is used to describe SOAP-based Web services.

The SOAP Web services can be difficult to invoke and use without its corresponding WSDL document. The ideal WSDL document should clearly indicate all usable and available RPC style methods of a service along with its arguments and return types. The WADL document is in a form of XML. The WADL document performs similar tasks to WSDL for a service. The WADL describes RESTful Web services. The simple and uniform interface of RESTful services render WADL less necessary.

2.7 Summary of the Chapter

This chapter presented the technical concepts of Web APIs, challenges of Web APIs and the long history of Web APIs with distributed systems. The section on Web API design discussed the three types of Web API architectures i.e. REST, RCP-style and REST-RCP based Web APIs. The chapter highlighted the strengths and weakness of each architectural style. The data exchange section focused on the two major data exchange formats. The data transmission section focuses on the delivery of messages to and from the server and client. Chapter Three explores the conceptual model underpinning this study and the related theoretical frameworks.

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CHAPTER 3.0   THEORETICAL FRAMEWORK

3.1   Technology Adoption Models

The body of knowledge of factors that influence technological innovation adoption is growing but literature shows limited research on the effects of the perceived attributes of innovation on technology adoption (Rogers, 2010). The most theoretical perspectives which contribute to the technology adoption body of knowledge is based on user behavioural intention. Between the several models that have been proposed. The Davis Jr (1986) Technology Acceptance Model (TAM) has been the most accepted model. The Davis model has substantial empirical support from recognized information systems and technology researchers. The other models of technology acceptance include the Theory of Reasoned Action (TRA), Theory of Planned Behaviour (TPB), and Unified Theory of Acceptance and Use of Technology (UTAUT).

Abu-Dalbouh (2013) suggests that TRA is a general model that evaluates an individuals' intended behaviour and is the basis of TAM (Figure 5). According to Wallace and Sheetz (2014), TAM is suggestive of the claim that adoption behaviour is determined by the intention to use the technology. The intention to use is then determined by the perceived usefulness and perceived ease of use of the technology. Despite the amount of empirical support for TAM, other studies argue that the fundamental constructs of TAM cannot fully explain the variance in user intention (Podder, 2005).
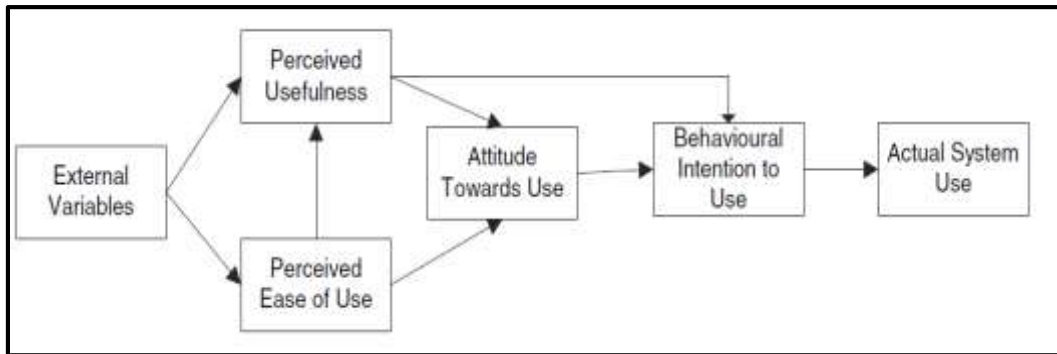
Figure 5: Theory of Reasoned Action (Fishbein, 1979)

Another Model used in technology adoption studies is Rogers (2010) Diffusion of innovation(DOI) theory. The DOI model proposed five characteristics of innovation that influence user adoption behaviour. These are relative advantage, complexity, visibility, trialability, and compatibility. Both TAM and DOI put emphasis on technology usage as a primary result of the adoption process, although Podder (2005) argues that DOI goes beyond that by explaining initial and continual usage separately. According to Lee, Hsieh, and Hsu (2011) TAM (illustrated in Figure 6) has always been the most favoured and widely used model when investigating technology acceptance. Podder (2005) is amongst other researchers who claimed that the DOI constructs explain a higher proportion of the variance than TAM when used as a theoretical background for the user intention to adopt technology.
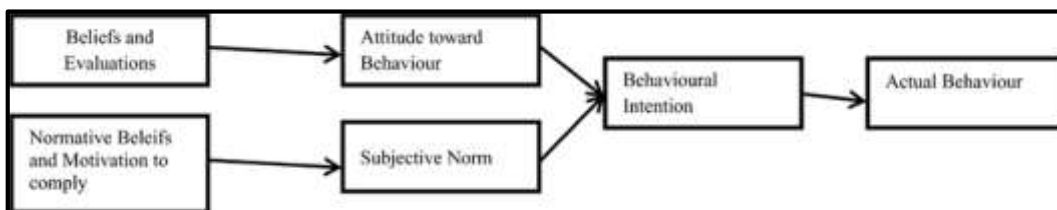
Figure 6: Technology Acceptance Model ((Davis Jr, 1986)

DOI aims to explain how innovations are taken up in a population and it has been tested in more than 6000 research studies(Robinson, 2009). Based on the argument for the relevance of the DOI theory for adoption based studies by Robinson, the current study will implement the DOI theory as the core component of the conceptual model that underpins the study's design. It should be noted however, that a study on the adoption of technology in a banking context necessitates the inclusion of constructs that allude to trust and security. In this regard, the original DOI perceived attributes of innovation are insufficient because of the study environment and technology innovation setting in question. The digital banking technology studies find factors such as trust and security & privacy to be major factors that influence technology adoption in this setting (Bozkurt et al., 2010; Liu et al., 2014; Vita, 2004; Wang et al., 2004).

The DOI model differs from other known models such as TAM by focusing on evolution and reinventing technology innovations. DOI takes a different approach from other theories of change and technology acceptance models. The DOI model (illustrated in Figure 7) recognizes that it is not people who need to be persuaded to change to accommodate the technology but the technology itself needs to fit into individuals or group's needs, values and beliefs for more effective and widespread adoption.
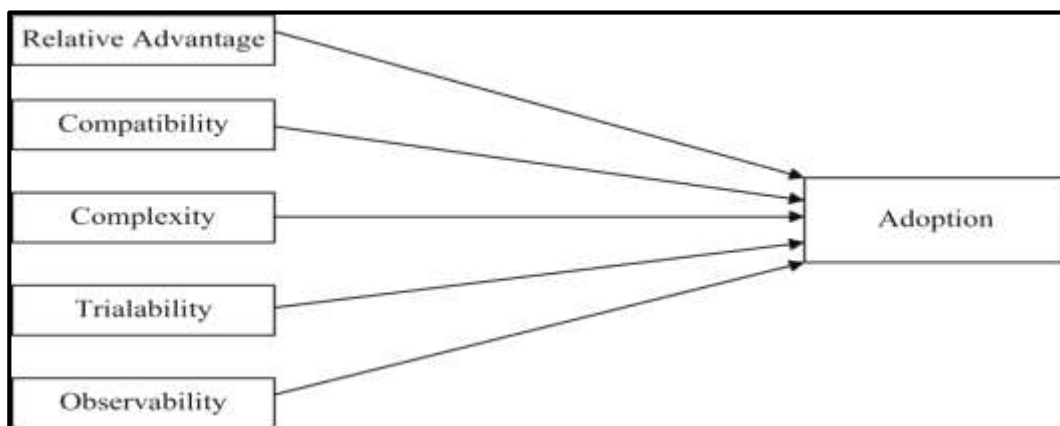
Figure 7: Rogers Perceived Innovation Attributes (Rogers, 2010)

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3.2   Conceptual Model Based on DOI

The study used a conceptual model based on DOI Theory. Many studies on IT adoption have used DOI constructs to develop a model to investigate the technology adoption levels (e.g. Podder, 2005; Scott, Plotnikoff, Karunamuni, Bize, & Rodgers, 2008; Yew Wong, 2005; Zhang et al., 2015). A significant observation in this regard is that studies on the adoption of Internet based technologies have used trust, security and privacy constructs to create an appropriate conceptual model. These attributes have also been used in studies of technology adoption in a Banking context (Carlos Roca, José García, & José de la Vega, 2009; Chellappa & Pavlou, 2002; Iashvili, 2012; Udo, 2001; Zaman, Khawaja, & Waqar, 2013).

The preceding observations have contributed towards the supplement (the addition of the constructs of Trust and Security) that is made to the DOI theoretical model as illustrated in Figure 8. This illustration represents the conceptual model that is implemented for the current study.
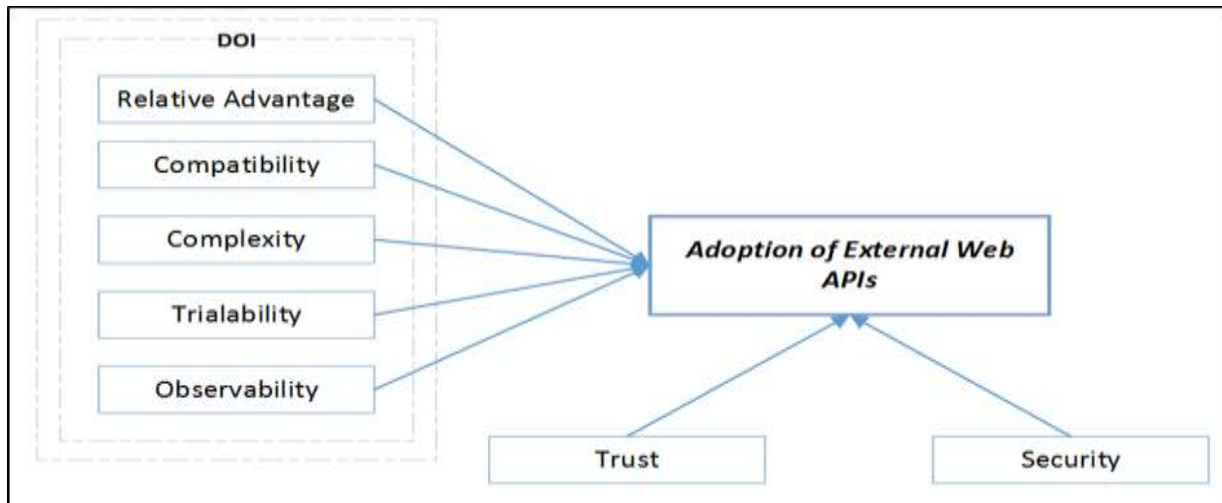
Figure 8: Conceptual Model based on Diffusion of Innovation Theory

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The DOI Theory has been used in the field of information technology for decades. Rogers model has been used by other disciplines besides technology for the past 30 years (Sahin, 2006). Rogers's diffusion of innovation is among the more popular theories in the field of technology used to examine the adoption of technological innovation (Zhang et al., 2015). Fichman (1992) argues that when the DOI Model is used effectively it can provide a useful perspective on the high rate of failed technology innovation implementation. Kaminski (2011) argues that Rogers' DOI theory can be applied as a change model when organizations adopt new technology innovations. The model can be useful in modifying the innovation to address the needs of intended users of innovation across all levels of adopters.

Rogers (2010) defines innovation adoption as a decision to use or reject a technology that is perceived to be new and innovation as a practice that is perceived as new by a unit of innovation adoption. Sahin (2006) defines diffusion of innovation as a process that occurs over a certain period of time. The innovation diffusion process takes place between members of a social system through a communication channel. According to Rogers (2010) adoption is influence by the relative speed at which innovation is embraced by members of the social system. According to Kaminski (2011) the diffusion of innovation process commences as an attempt which will either succeed or fail over time. Rogers (2010) definition of diffusion of innovation outlines four key elements:

1. *Innovation*:

   According to Rogers (2010) innovation does not have be new as long as it is perceived new by the social system adopting it. The API technology has been in existence since the beginning of software development practice, but the concept of external Web APIs in Banking is perceived to be new due to its limited use.

2. *Communication channels*:

   This is the medium used to communicate details about the innovation.

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3. *Time*:

   Time plays a role in the diffusion decision process of DOI model and also in the innovativeness of the organization and units within the organization. Innovativeness refers to how early the organization or unit within organization is on adopting new ideas.

4. *Social systems:*

   Rogers (2010) perceives a social system as integrated set of units that collectively solves problems to achieve a common goal.

The RESTful APIs are not new as Fielding (2000) introduced the REST architecture in 2000 but the Banking industry perceives the practice as new, especially the concept of external RESTful APIs. The innovation adoption can be influenced by the five perceived characteristics of the innovation identified by Rogers (2010) in the model of diffusion of innovation (Sanson-Fisher, 2004). According to Rogers (2010) the five perceived and universally relevant characteristics of innovation listed below have a major impact on the of innovation adoption.

1. *Perceived relative advantage*- Relative advantage evaluates whether the idea is perceived to be better than the idea that it supersedes. According to Rogers (2010) relative advantage includes financial benefits and social status. The relative advantage cannot be pre-defined in some cases only the users can decide which qualities of innovation they perceive as advantageous. The perceived relative advantage has a positive effect on the adoption of innovation (Sanson-Fisher, 2004).

2. *Perceived compatibility*- This element investigates whether innovation is in line with how the group operates. Perceived compatibility has a positive effect on the adoption of innovation (Sanson-Fisher, 2004).

3. *Perceived complexity*- According to Robinson (2009) The more complex the technology innovation; the more resistant the users will be the adoption thereof.

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Perceived complexity has a negative effect on the adoption of innovation (Sanson-Fisher, 2004).

4. ***Perceived trialability***- This attribute questions whether or not an innovation provides an easy opportunity to test and modify it before adoption. This attribute has a positive effect on the adoption of innovation (Sanson-Fisher, 2004).

5. ***Perceived observability*** – The adoption results of technology innovation should be visible in order to attract new adopters. The visible positive results has a positive effect on the adoption of innovation (Sanson-Fisher, 2004).

The Banking industry has been using internal Web services for more than a decade but the adoption of external Web APIs has been slow (Vita, 2004). The perceived attributes of technological innovations may either add to or decrease uncertainty levels of users during the innovation diffusion process. User uncertainty levels regarding innovation have a direct impact on the adoption (Kaminski, 2011). The innovation attributes by in Rogers (2010) DOI model, together explain 49-87 % of the variance in the innovation adoption.

The use of Web APIs like SOAP and REST by organizations with large digital presence have been increasing, there are some noted mission critical external RESTful APIs within the financial industry such as PayPal and VISA payment Web APIs (Mumbaikar & Padiya, 2013). The aforementioned is evident of the visibility of results in the adoption of external Web APIs by banking institutions. The technological benefits of external RESTful APIs such as code reuse and using pre-existing technologies translates to financial benefits for the implementation of external RESTful APIs (Albreshne et al., 2009). The development of external RESTful APIs is regarded as relatively simple and require less effort (Adamczyk et al., 2011).

Perceived Trust and Security & Privacy

The security dimension is a major influencer in the adoption of e-Banking technology and has a significant positive effect on the adoption of e-Banking (Liu et al., 2014). The perceived security dimension has two categories according to Liu et al. (2014), namely

operational, and policy. The information privacy refers to the ability of an organization to ensure the customer sensitive data is not being used for more than its intended purpose without customer consent (Carlos Roca et al., 2009). The systems security intrusions result in an increased negative perception by customers towards internet transactions. banks operate in a strictly regulated environment and according to Carlos Roca et al. (2009) the perceived image of a Bank depends on trust; therefore building and maintaining trust is crucial for the success of the Bank.

The impersonal nature of online interactions requires a different approach in building trust especially in banking where business processes involve sensitive personal and financial data being transmitted online (Liu et al., 2014). In banking the security of data plays an important role in defining and building trust (Kołaczek et al., 2015). The security concerns and limitations of Web services introduces challenges in securing communication in which Liu et al. (2014) suggest that establishing trust between services will remedy this limiting situation.

The information systems literature shows a strong correlation between trust, security and privacy in Web APIs and the vital role that trust and security plays in adoption of internet technology solutions. The two concepts trust and security are used as the basis from which to investigate the adoption of Web API by Absa South Africa. The study is academically contextualised by Rogers (2010) perceived attributes of innovation.

3.3 Summary of the Chapter

Chapter Three discusses in detail the various theoretical frameworks currently being used in the field of information systems research with regard to the adoption of technology. The chapter provided details about the conceptual model developed for this study which is based on the DOI theory. The conceptual model underpinning the study is centred on the constructs underpinning the DOI theory. These constructs are supplemented by the additional constructs of perceived trust and security to provide a complete, holistic conceptual framework to underpin the current study.

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CHAPTER 4.0   RESEARCH METHODOLOGY

4.1   Introduction

Chapter Four provides details on the guidelines followed to conduct the study. The current chapter provides details about the research design and paradigm employed in the study and the target population. Furthermore, Chapter Four gives details about the data collection instruments utilized in this study. The study will be using a mixed methods approach. The initial phase of the study will be qualitative and entails the use of interviews with managers to enable a deeper understanding of issues that influence the adoption of external Web APIs in the Banking sector. The qualitative phase will be followed by a quantitative phase where a survey type approach will be used to obtain a more structured response from software development practitioners with regards to their perceptions and intention to adopt external Web APIs.

4.2   Research Design

According to Lewis (2015) there are five traditions of qualitative enquiry, namely grounded theory, narrative research, phenomenology, ethnography and case study. The suitable tradition depends on the purpose of that particular research. According to Wiles, Pain, and Crow (2010) evaluating factors that impact the innovation adoption levels is a complex process which requires an in-depth enquiry. The current study intends to investigate the various factors that affect the adoption of technological in a Banking setting. The preference to use Absa Bank as the site for the study emanates from a purposive perspective because Absa Bank is currently implementing a strategy for the use of Web APIs. This knowledge coupled with the researcher's vantage point of obtaining access to information regarding the use of Web APIs at Absa Bank makes the choice of a case study approach an ideal one.

4.3   Case Study Research

The case study tradition is a rigorous and effective approach to research. According to Yin (2013) a case study approach is an extensive examination of a single unit class of phenomena. The case of this study may be expressed as *the adoption of Web APIs by Absa Bank South Africa.* The decision to use a case study approach is influenced by various circumstances such as the nature of the research question e.g. investigating the 'how' and 'why'.

Case study research is an approach that provides a framework for exploratory research in real-life settings (Baxter & Rideout, 2006). The case study approach is mainly adopted in projects where the aim is to go in-depth on a specific case and present a complete analysis of the findings (Knutsson, 2016).   Case studies can autonomously follow research paradigms   i.e. qualitative and quantitative (Knutsson, 2016). Quantitative case studies focus on reaching conclusions for various hypotheses using statistical methods, whereas qualitative case studies focuses on understanding the source of the problem of a single unit and extracting insightful knowledge to be used to increase the perspective for a larger number of units.

Hyett, Kenny, and Dickson-Swift (2014) describe qualitative case study research as "drawing together of naturalistic, holistic, ethnographic, phenomenological, and biographic research methods". According to Darke, Shanks, and Broadbent (1998) case study research is generally used in the field of information systems and is valuable when conducting qualitative research pertaining to technological innovations. Hyett et al. (2014) are of the opinion that the case study research design offers unique flexibility that is often not available in other qualitative methods such as phenomenology. The published studies that followed a case study design showed major diversity in the design of the study; this could be ascribable to the lack of formal guidelines in other areas of a case study such as data analysis. Despite the limitations and challenges associated with case study design

(such as it being expensive, time consuming and difficult to integrate outcomes collected from several cases) case study design is a rising qualitative method.

The Web APIs have been in existence for more than a decade but the concept of external Web APIs in Banking is fairly new and can be considered as contemporary which makes the study a good point of reference for a case study design. The qualitative case study relies on several verifications. This study uses a mixed method approach with more than one paradigm. Precedence will however be accorded to the qualitative aspect of the study because it enables a more detailed and "intimate" engagement with the main variables of the study.

According to Knutsson (2016) the case study is the preferred method when the study hypotheses and questions are based on constructs that are conceptual. The current study is based on a conceptual framework which comprises of multiple constructs from more than one theoretical disposition. According to Hyett et al. (2014) data collection for a case study may be derived from more than one source. The current study will use 2 different data collection instruments that have been developed specifically for the qualitative and quantitative component of the study.

4.4   Research Approach/Paradigm

The information systems and technology researchers have adopted different research paradigms that can be broadly categorized as quantitative and qualitative method. According to Hopkins (2008) the quantitative paradigm is based on positivism, where reality is explained by scientific methodology that espouses to a philosophy of objective truth and rigorous analysis that produces results that are generalizable and repeatable. The quantitative methods can either be descriptive or experimental with the former being limited to discovering associations between variables while experiments are used to establish causality (Muijs, 2010). The qualitative methods are based on the interpretivist and constructivist philosophy (Sale, Lohfeld, & Brazil, 2002) where reality is viewed as subjective and context-bound. The qualitative methods such as interviews, observation and

content are focused on obtaining and analysing data that is "rich" in content and meaning. The purpose of qualitative analysis is to investigate deeper into the given problem to uncover hidden trends and themes. According to Venkatesh, Brown, and Bala (2013) qualitative research methods in information systems are predominantly employed in a research design that is exploratory and seeks to uncover possible relationships that may be subjected to further testing via quantitative methodology

A significant number of studies in information systems have employed these methods individually in autonomous studies, thereby creating a culture of methodological diversity in information systems research (Venkatesh et al., 2013). This diversity is regarded as a major strength for information systems research, however this diversity has failed to create pluralism as expected in information systems research. The methodological pluralism is formally known as mixed methods and it combines more than one research methods in a single study. According to Venkatesh et al. (2013) only a limited number of studies have used methodological pluralism in information systems research.

The debate around social and behavioural science research and mixed methods has a long-standing history (Cameron, 2009). These debates, according to Venkatesh et al. (2013) are based on the relative value of different epistemologies i.e. positivist and interpretive. The debates span across the relative value of different research methodologies. According to Cameron (2009) each research methodology is an alternative method with its own merits, therefore argument for dominancy of one methodology over others is insignificant. Hussein (2015) suggests that both methodologies have strengths and weaknesses but both are designed for a singular purpose which is elaborating on a particular area of interest. According to Sale et al. (2002) When research methods are combined they can complement each other through the use of strength pertaining to one method, to enhance the other. The combination of both qualitative and quantitative methods in one study serves to provide an in-depth understanding of the phenomenon (Venkatesh et al., 2013).

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Sale et al. (2002) contend that the debate on pluralism is no longer a subject to debate and researchers are now at liberty to conduct valuable research using mixed methods. According to Venkatesh et al. (2013), it is vital that information systems researchers employ mixed methods more often in order to take advantage of the value pertaining to such methods, with respect to extracting and forming a more in-depth understanding of complex phenomena. This study will follow the mixed methods approach particularly to take advantage of the strengths provided by each method individually and plural. Sale et al. (2002) highlights two reasons for the combination of the paradigms in a single study. These are to achieve a complementary outcome through the use of strengths of one method and to enhance the other method as well as to achieve triangulation where the results obtained in the methods individually serve corroborate each other. It is envisaged that the use of methodological pluralism in the current study will enable a broader understanding of the research questions thereby enabling an informed discussion.

They are four major types pertaining to the mixed methods approach i.e. triangulation, embedded, explanatory, and exploratory Creswell, (2013). This study will employ a sequential exploratory design which follows three phases as illustrated in Figure 9. The first phase will be the qualitative data collection and analysis phase; and the second phase will be quantitative data collection and analysis. The focus of this study will be placed on the qualitative data phase (Creswell, 2013) where the essence of the phenomenon of Web API adoption will be obtained via in-depth interviews with IT managers at Absa Bank. The second phase will entail a quantitative approach where a survey will be administered to software developers at Absa Bank. The survey will be conducted purposively so as to target those developers who have been exposed to the use of Web APIs and have the option of using the technology. The final phase will entail a discussion of results from the individual phases and the possible corroboration of results from the individual phases. The final phase is referred to as the triangulation phase. Triangulation will use the quantitative data to assist in the interpretation of the qualitative findings (Hussein, 2015).

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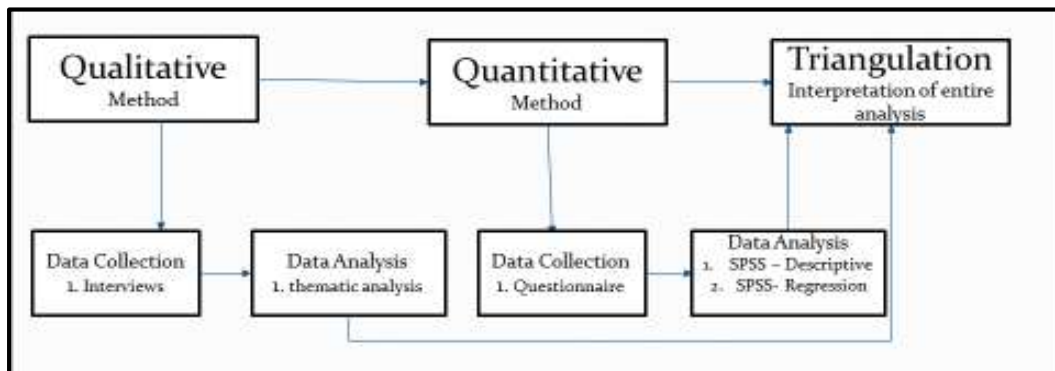
Figure 9: The Sequential Exploratory Research Design

4.5   The Study Site

Borrego, Douglas, and Amelink (2009) define a study site as a physical location where the study will be conducted. This study will be conducted at Absa Bank head offices in Johannesburg central South Africa.

4.6   The Target Population

The target population can be defined as a collection of objects that share specific characteristics (Trochim & Donnelly, 2001). The targeted population is the employees of Absa Bank South Africa (technology division) who are involved in software development

4.7   The Sample

According to Teddlie and Yu (2007) a sample is a portion of the targeted population that represents the entire population of interest. The sample used for the current study will be selected purposively on the basis of their knowledge and experience in the domain of Web API implementation. Based on the preceding purposive specification the sample has been identified as the heads of departments and senior members who have an influence in the decision making with regards to the type of technologies that are employed at the Absa

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Bank technology division. The sample will also include analysts and developers who are currently involved in use of Web API technology at Absa Bank.

4.8   The Sampling Method

The sampling process entails selecting population units that can be utilized to fairly generalize results and with enough information to answer the research questions (Trochim & Donnelly, 2001). The study uses a mixed methods approach which combines qualitative and quantitative paradigms for efficiency, to improve reliability, validity of data collected and accumulate a rich set of data (Teddlie & Yu, 2007).

In line with the approach to be used in this study, a mixed sampling strategy will be selected in support of the overall research approach and to accommodate both paradigms. Two representative sampling methods were selected for this study namely, stratified random sampling and purposive sampling. The purposeful sampling strategy is widely adopted in qualitative case study research to identify and select cases rich in information when resources are limited (Palinkas et al., 2015).

The purposive sampling technique is mostly used to select individuals who are knowledgeable in the phenomenon of interest (Teddlie & Yu, 2007). The stratified random sampling technique is widely used in quantitative research and it is applied when a researcher is interested in drawing a random sample that represents a population with specific characteristics of interest (Palinkas et al., 2015).

4.9   Data Collection Instruments

According to Baxter and Rideout (2006) using more than one data sources in a case study enhances data credibility. This study will employ mixed method and each paradigm will use its own data collection instrument.

*Interview Instrument (See **Appendix A** for the full set of Interview Questions)*

The qualitative paradigm will uses in-depth interviews. According to Darke et al. (1998) the focus of a case study is on the in-depth understanding of the phenomenon, hence the use of the in-depth semi-structured interviews. The study will use an in-depth semi-structured interview to collect rich and focused data to identify and understand issues with regards to the adoption of Web APIs by Absa Bank. Semi-structured interviews will be used to provide the interviewer with sufficient flexibility to engage all interviewees at their designated levels and obtain the best information they could possibly provide; whilst still answering the same questions used to collect data (Brinkmann, 2014). The interviews will be conducted face to face with senior managers or heads of departments within the Information Technology division. Although the interviews will be face to face, the potential interviewees will receive questions prior to the interview to allow them to become familiar with the context of the study and the details required.

The quantitative section of the study will be conducted via a survey approach where closed ended questionnaires will be disseminated to a sample of 40 IT personnel. A stratified approach was used to select a random sample consisting of 10 developers from each of the 4 main software development divisions within Absa. Each division was further stratified to ensure that at least one of the systems analysts from each division were selected to participate in the quantitative component of the study. The questionnaires were disseminated to the respondents via email. The questionnaire items were adopted from multiple published research studies (Listed in Table 3 below). The items of the questionnaire represent eight dimensions i.e. Trust, and Security & Privacy, together with perceived Relative advantage, Compatibility, Complexity, Trialability, Observation and Willingness to adopt.

Questionnaire Instrument for the Quantitative Study (Refer to Appendix B for the full set of Survey Questions)

This study questionnaire instrument will make use of Likert Scale type of questions which can be defined as a psychometric scale (Nemoto & Beglar, 2014) that enable quick,

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convenient and somewhat accurate responses to a question in a minimally disruptive manner. The questionnaire will have multiple categories based on the independent (attributes of Web APIs) and the dependent variable (adoption of Web APIs) of the study. The respondents indicated their attitudes, opinions or feelings toward the questions using a Likert Scale range extending from 1 to 5, where:

1= 'Strongly Disagree'

2= 'Disagree'

3= 'Neutral'

4= 'Agree'

5= 'Strongly Agree'

In order to contextualise the questionnaire items, Table 1 below is used as source of reference for the origins of the questionnaire items. This table has been entered into the discourse in order to confirm the academic essence of the questions asked as well as to enhance the validity of the questionnaire.

Questionnaire items showing studies they were adopted from.

Table 3: Questionnaire Sample

The Rogers (2010) Perceived Innovation Attributes, Trust, Security and Privacy Questions	*Reference*
External Web APIs/ Services is compatible with the technological infrastructure that I work with	(Walker, 1999)
I am able to try out a Web API interface without being too concerned about the consequences of failure	(Walker, 1999)

I feel safe when I release information to third parties through External Web APIs/ Services	(Maqableh, Moh'd Taisir Masa, Shannak, & Nahar, 2015)
I believe that making use of third party External Web APIs/ Services is likely to be safe	(Maqableh et al., 2015)
External Web APIs/ Services improve my efficiency when I use them.	(Scott et al., 2008)

The questionnaire instrument assesses seven primary factors that were identified as possible predictors of the level of Web API's adoption at Absa Bank. The questionnaire instrument is made up of three sections. Two major section were about the conceptual model constructs i.e. Roger's attributes of innovation, trust and security and privacy. The third section is the intention to use Web APIs.

The first major section seeks to establish whether the Rogers' perceived innovation characteristics have an influence on the adoption of External Web APIs/ Services by Absa Bank. This section has five constructs: Relative advantage, observability, complexity, trialability and compatibility. Each construct have more than three items that were used to calculate that specific construct. The second major section seeks to establish whether the trust and security & privacy have any influence on the adoption of External Web APIs/ Services at Absa Bank.

The compatibility construct was measured using three items on a scale of one to five.

Table 4: Compatibility Items

External Web APIs/ Services are compatible with the technological infrastructure that I work with
External Web APIs reduce the amount of time it takes to develop software
It takes a great effort for me to make use of external Web APIs.

The study compatibility items were based on Rogers (2010) perceived compatibility element. According to Rogers (2010) if the innovation is compatible with the existing processes, infrastructure, values or beliefs of the users it is likely to be adopted faster. The trialability element was measured using three items indicated in table 3. If users get an opportunity to try out the innovation before adoption, this may increase the chances of adoption(Zhang et al., 2015).

Table 5: Trialability Items

I am able to try out a Web API interface without being too concerned about the consequences of failure
It did not take me much time to try external Web APIs before I finally accepted their use
It is better to experiment with External Web APIs/ Services before adopting them.

The relative advantage construct was measured using three items based on ease of use and advantage as a benefit as illustrated in Table 6.

Table 6: Relative Advantage Items

Mistakes with External Web APIs/ Services **are easier to correct** than traditional applications
Mistakes **are more likely to occur** with External Web APIs/ Services than usage traditional applications
External Web APIs/ Services provide an advantage over traditional applications.

The observability construct used three separate items in Table 7. The items evaluate the influence of visible results on the willingness to adopt web APIs. According Rogers (2010) visible results of successful initiatives will have positive influence on the willingness to adopt.

Table 7: Observability Items

I was influenced by what I observed as the benefits of using External Web APIs/ Services
I observed others using External Web APIs/ Services and saw the advantages of doing so
There is no need to observe others using Web APIs before I make use of it.

The complexity is the fifth construct of the study that is based on Roger's Diffusion of Innovation. The influence of complexity on the willingness to adopt was measured through three items listed in Table 8.

Table 8: Complexity Items

External Web APIs/ Services are difficult to understand and use
External Web APIs/ Services are convenient to use
It is easy to use External Web APIs/ Services even if one has not used them before.

Security and trust are two other constructs of the study that are based on the literature of banking technology. According to Carlos Roca et al. (2009) trust is significant predictor of willingness to adopt in a Banking setting. The items in Table 9 were used to evaluate the influence of trust on the willingness to adopt external Web APIs at Absa Bank.

Table 9: Trust Items

I believe that making use of third party External Web APIs/ Services is likely to be safe
My web service interaction with other External Web APIs/ Services is likely to be reliable
Many things may not go wrong with my interaction with other External Web APIs/ Services
I am confident that third party interaction with my web service will be transparent.

Security is the last independent construct. Security is also indicated as major factor in adopting technology in Banking. Table 10 show the items that were used to measure the influence of security on the willingness to adopt external Web APIs at Absa Bank.

Table 10: Security Items.

I trust the ability of web service to protect our customer privacy
External Web APIs/ Services provide secure data transmission channels to secure all interactions between the third party and my web service
Web service technology provides the latest security prevention technologies to prevent unauthorized access to External Web APIs/ Services
Web service technology provides the latest security detection technologies to prevent unauthorized access to External Web APIs/ Services
Web service technology provides the latest security response technologies in cases of unauthorized access to External Web APIs/ Services

	I feel safe when I release information to third parties through External Web APIs/ Services.

The dependent construct 'willingness to adopt' was measured using selected items from a questionnaire that a researcher deemed qualified to predict the attitude of respondents towards the adoption of external of Web APIs Stachewicz (2011). The items are listed in Table 11.

Table 11: Willingness to Adopt Items

Items No	Instrument questions	Construct
1	External Web APIs/ Services improve my productivity when I use them.	Willingness to adopt
2	I intend using Web APIs to enhance my job performance	Willingness to adopt.

The instrument items were adopted from various published studies in information systems research. The overall instrument was validated through a short pilot study and statistical tests.

4.10 Data Quality Control

According to Golafshani (2003) data quality control refers to the ability of a researcher to ensure the reliability and validity of the research instruments .

The study instrument reliability refers to the ability of the instrument to replicate the same results of the study over time (C. H. Yu, 2005). The instruments reliability is determined by the accurate representation of the total population being studied and producing constant results. The instrument validity refers to its ability to assess what it is intended to asses (Golafshani, 2003). The study conducted a short pilot study at the Absa Bank technology division on senior employees working with Web APIs to ensure validity of the interview instrument. The pilot study ensured that the interview questions are sufficient to answer the research questions.

The questionnaire instrument contained reverse coded items to increase the validity and reliability of this instrument. The study also employed triangulation strategy by using and comparing findings from both instruments to improve reliability and validity of the study. The Cronbach's Alpha analysis was conducted to measure internal validity of each construct using Cronbach's coefficient alpha value (Gliem & Gliem, 2003).

4.11   Data Analysis

The study uses both qualitative and quantitative method. Data analysis is the process of analysing raw data with the aim of making it sensible; create information and knowledge to draw viable conclusions. Thematic analysis was used on qualitative data from the interviews. According to Braun and Clarke (2006) this method is widely used in qualitative analysis. This approach offers an accessible and flexible strategy to conduct qualitative data analysis. The thematic method identifies themes and categories within data in order to formulate information that can be reported as findings. The study also used the Statistical Package for Social Science (SPSS) to validate and analyse quantitative data.

4.12   Ethical Considerations

The ethical clearance for this study was requested from the University of KwaZulu-Natal Ethics Committee and approved before data collection. The gate keeper's letter was

requested from the Registrar's office at the University of KwaZulu-Natal and presented to Absa Bank South Africa. Gate keeper approval was obtained from Absa Bank to conduct the study at the Banks' head offices as well as to enable access to employees of Absa Bank for the purpose of the study. The informed consent was attached to questionnaires to ensure respondents were made aware of the voluntariness option with regards to participation in the study. The informed consent also informed respondents about the right to privacy and confidentiality.

4.13   Summary of the Chapter

Chapter four of this research project focuses on the overall plan in place to conduct the study. The chapter outlined the research design, research approach and sampling methods. The case study design and mixed paradigms approach was adopted to guide for this study. The data was collected following a sequential exploratory mixed method approach. They were two phases in data collection. The first phase were interviews conducted face to face with the senior employees of Absa Bank technology division. The second phase of data collection was conducted through questionnaires. The following chapter is based on the analysis of data corpus using various analysis tools and methods for both qualitative and quantitative data.

CHAPTER 5.0   FINDINGS AND ANALYSIS

5.1   Introduction

This section of the study focuses on data analysis of the collected data through interviews and questionnaires. The study employed the mixed methods design, in particular the sequential exploratory design. This design follows two phases. The first phase of this research design is qualitative data collection and analysis. The second phase is quantitative data collection and analysis, thereafter a triangulation will take place. The triangulation phase will entail validation of the qualitative data analysis by incorporating the quantitative dimension

5.2   Qualitative Data Analysis

The first phase of the sequential exploratory design is based on the qualitative data collected through6 interviews. Qualitative data is meanings expressed in text and actions; often presented as richer and more valid when compared with quantitative data. According Miles, Huberman, and Saldana (2013) qualitative analysis is the process of defining phenomenon, classifying it and as well as seeing how emerging research themes interconnect. Qualitative data analysis often takes place alongside data collection. The initial data collection is analysed and it will continuously shape the ongoing data collection. This process of parallel analysis and data collection affords the researcher an opportunity to refine questions and to pursue new emerging lines of inquiry (Braun & Clarke, 2006). In order to contextualise the first phase of the data analysis, research design is re-presented in Figure 10 below.
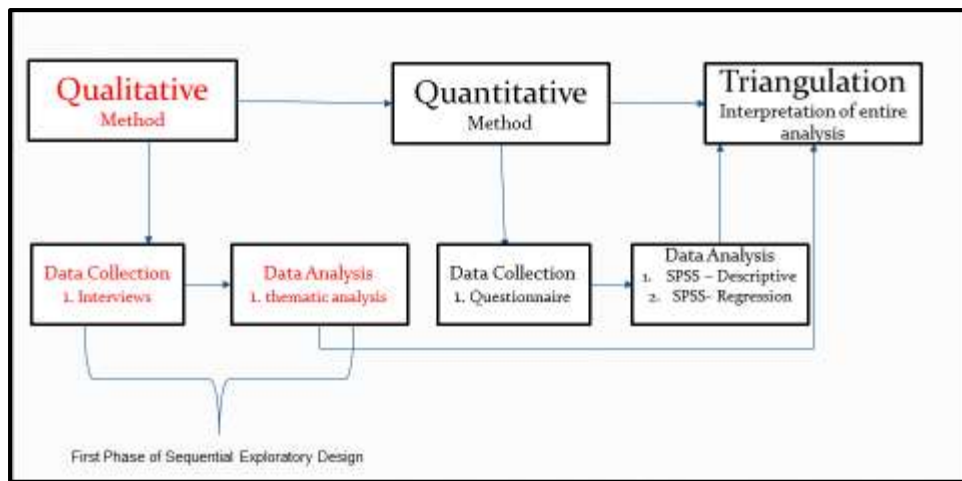
Figure 10: Phase one of the Sequential Exploratory Design

5.2.1 Interview Protocol

Each interview session was divided into 2 main different parts. The first part was an explanation of the study's objectives, the informed consent and the elicitation of demographic and background information of the respondent. The 2nd part of the engagement was the actual interview.

To ensure maximum efficiency the questions remained the same for all the interviewees except with how they were presented. The variation in the presentation of questions ensured that the questions remained valid for every respondent. The respondents had different backgrounds and each respondent was purposefully selected to participate for exactly that as such the questions had to be presented in a way that was deemed suitable for each respondent.

The interviewees were encouraged to share past experiences with regard to the external Web APIs and the use of APIs in general. The environment for the interviews was informal and this was done to make both the interviewer and interviewee feel comfortable and relaxed enough to go in to details when answering questions. The interviewees received a

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copy of the interview questions in a prior email communication as well as a printed version during the interview session itself.

At the end of a session the interviewees were given an opportunity to comment in an open demeanour on the viability of APIs in the Banking sector and specifically at Aba Bank. The interviewees were thanked for participating and given a contact details should they wish to further comment on the research questions

5.2.2   Thematic Analysis

The qualitative data analysis of this study was done using thematic analysis. According to Braun and Clarke (2006) thematic analysis offers a flexible approach to qualitative data analysis. In simple terms thematic analysis is identifying, analysing and reporting themes within the data set. The coding was done manually based on the theoretical framework underpinning the study. According to literature in content analysis a few questions have answered before transcribing interviews such as whether to transcribe all the interviewer questions or to be guided by the main question. The study uses main questions for guidance for the two reasons. The interviewees were experts in the field of Banking technology and the topic fascinated them to a point where some wanted to engage in a debate, since the questions were semi-structured it allowed them to discuss other related topics which are not important with regards to the research objective. The unit analysis or themes for the study were identified through inductive reasoning. Themes emerged from the careful and iterative analysis and constant comparison of data. The categories for coding were identified through deductive reasoning, using the study's theoretical framework variables and relationships.

The thematic analysis was carried out following the six steps identified by Braun and Clarke (2006).

- Phase one: Familiarizing yourself with your data

According to Braun and Clarke (2006) regardless of who collected data as a researcher it is vital to go through data set numerous times. Take notes of possible codes (meaning labels attached to chunks of transcription data with the intention of reducing and condensing the data for further analysis).

'*Phase one was done through transcribing audio interviews'*.

- Phase two: Generating initial codes

When one is confident that they familiar with every aspect of the set and have a list of ideas from Phase 1 they can begin Phase 2. In Phase 2 a researcher must decide whether or not the codes are based on a theory. Codes may be developed to align with specific interview questions which are in turn based on theory or previous knowledge. The other option is to have data driven codes that are developed in an exclusively inductive manner. A hybrid approach could also be used where the codes are derived deductively from existing knowledge or inductively from the data. This hybrid approach is followed in the current study.

- Phase 3: Searching for themes (inductively)

Phase 3 begins with a list of codes from Phase 2. The codes are sorted into possible themes and sub-themes using mind maps or tables. In Phase 3 relationships are formed between themes, sub-themes and even codes.

- Fourth Phase: Reviewing themes

Phase four involves reviewing and refining the candidate themes in two levels. Reviewing themes starts at the coded data extracts level by taking each theme through collated extracts with the aim to test for coherent patterns. If the candidate theme tested positive for coherent patterns, then a level two review starts. The level two review is similar to level one but uses the entire data set.

- Phase five: Defining and naming themes.

Phase 5 begins when there is a valid thematic map for the data set. Based on the sequence outlined in phases one to four, a thematic map for the current study has been developed (illustrated in Figure 11 below). At this stage, each theme should

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be refined and defined to understand its very nature; what the theme is about and how it fits with the other themes. The output of phase five is a detailed analysis of each theme.

- Sixth Phase: Producing the report

Phase 6 begins when there is a valid set of themes. Phase 6 requires a researcher to complete a thematic write-up. The report should simplify the meaning of the data and present it a convincing manner.
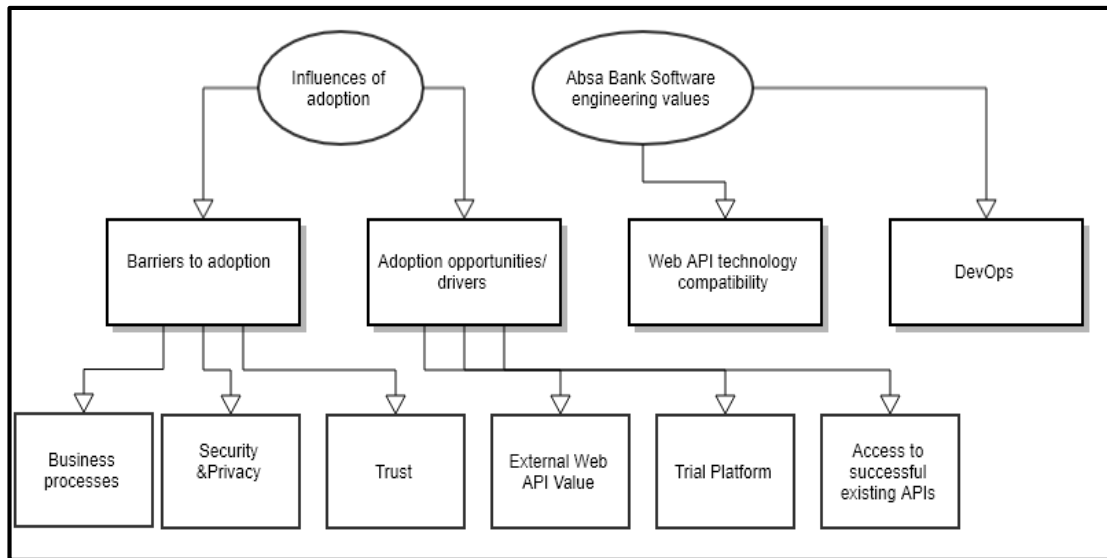
Figure 11: Thematic Map for Phase 5

5.2.3   Interpretation of Qualitative Data.

The interpretation of qualitative data of this study continues from Braun and Clarke (2006) sixth phase of thematic analysis. According Clarke and Braun (2013) the sixth phase is the integral part of thematic analysis. Writing the report of thematic analysis requires combing analytic narrative and data extracts to simplify the narrative of the data in order to tell a coherent story. The report should tell a persuasive narrative with regards to the data. The persuasive narrative requires a researcher to contextualize the narrative and data extracts

with the existing literature. The write up will cover all the themes associated with the questions of the study. Figure 7 above shows all the final themes that were constructed in phase five of Clarke and Braun (2013) thematic phases.

Theme 1: External Web API Value

Theme 1 of thematic analysis represents a perceived relative advantage of Rogers (2010) perceived innovation attribute.

The respondents mentioned various benefits that influenced the decision to adopt external web APIs. The majority of values mentioned by respondents were financial, operational and technological benefits. According to Walker (1999) perceived relative advantage could be cost related. The respondents were all in agreement that the value of using external Web APIs is a contributing factor to the decision of adopting APIs.

"A lot more business; it's a lot more flexibility with regards to who is able to invoke what. You have a lot more consumers that are willing to use them because everything is readily available" –integration developer at IBM API management.

"*Advantage of this specific API is not just a local solution is actually international solution so we won't be helping South African client will also be helping clients that are International*' –API manager lead.

"Aggregating data will add value" –*Senior Manager in Service delivery*

"*I think the biggest advantage for those that provide APIs is that you don't have to do, provide all the answers so if there is a Bank offering API to customers or partners we don't have to dream up of all the services we can possibly think of, the external parties can actual leverage our APIs and add more value to it*' –enterprise architect.

Theme 2: Access to successful existing external Web APIs.

Theme 2 of thematic analysis represents perceived observability of Rogers (2010) perceived innovation attribute. According to Kaminski (2011) perceived observability element questions whether the results of successful initiatives are visible. The majority of

respondents were in agreement that a Bank has a platform where Bank's APIs are visible. The respondents are also in agreement that having a view to these successful initiatives influences the decision to adopt external Web APIs.

"Yes so API manager, that solution have a developer portal, so in that portal all the APIs being published in the Bank is available to the developer community and they actual can go into the portal that I can look at that I can see what functionality on their own systems on the Portal itself" –line manager in API manager space.

"*Oh actually yes we do. We have certain divisions in Absa that have access to API manager"* –integration developer at IBM API management.

Although this tool is available and the respondents agree that it does influence the decision to adopt APIs, when they were asked if it is visible to the entire developer community they agreed but there was uncertainty on whether the developers are all aware of this tool.

"*Going back to my comment the younger teams that the teams that are more robust and of familiar with technology they are yes, they been engaging with us, I think being in the CTO the visibility of the functions that behind API manager is becoming more and more clear to the Bank but it will still take some time to get everybody on-board*" –line manager in API manager space**.**

Theme 3: Trial Platform

Trial Platform theme of thematic analysis represents perceived trialability of Rogers (2010) perceived innovation attributes. The same platform from the visibility attribute is used to publish demo APIs according to the integration developer at IBM API management.

"We have a developer portal, so in that portal all the APIs being published in the Bank is available to the developer community" –line manager in API manager space

When interviewees were asked if such a tool influences the decision to use external APIs, most respondents agreed.

"*Ya it has to if can't test it you can't use it"* –Head of Risk for CTO**.**

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"Yes alright because this functionality is there, why not use it right?" –integration
developer at IBM API management.

The responses indicated that if the developer community has access to a demo platform where they can explore new or existing Web APIs they may be influenced to adopt external Web APIs.

Theme 4: Absa Bank Software engineering values

The compatibility theme of thematic analysis represents perceived trialability of Rogers (2010)' perceived innovation attributes. According Kaminski (2011) compatibility of innovation refers to the ability of technology to blend with the users values and beliefs. Absa Bank's Software engineering value theme represents the compatibility element. The respondents believe that external Web APIs compliment the values and believes of software engineering at Absa Bank i.e. Agile and DevOps.

"They kind of complement each other" –Enterprise Architect

"I think it's a 100% complimenting it" –Chief Technology Officer

"I do"– line manager in API manager space.

Theme 5: Design complexities

The complexity of external Web APIs in terms of design, access control, data transmission and testing represents the complexity element of Rogers (2010) perceived innovation attributes. The expert in API integration stipulated that no aspect of external Web API is too difficult to implement. According to the interviewees the external Web APIs are less complex in nature and this does negatively affect the levels of Web API's adoption at Absa Bank.

"Not at all" –integration developer at IBM API management

"If you can't use it because you don't know how to do one of those things you should and shouldn't be seen as a barrier" -Head of Risk for CTO

"If you know what you doing it doesn't look too complicated" –Senior Manager in Service deliver

The responses to complexity of external Web APIs seem conclude that the people, rather than the technology are the problem, as such may lack skills. The key technical building blocks of external Web APIs mentioned in the interview question does not seem to be a barrier but an opportunity or advocate of the adoption.

"It actual improves testing to have APIs cause you can call something to test for you whatever it may be" –Chief Technology Officer

Theme 6: Security & Privacy

The perceived security and privacy of external Web APIs interview questions investigated whether the Bank has concerns about losing customer information through external Web APIs. The respondents seem to be concerned at different levels and different views.

"Yes but that's part and parcel of the decision process on what APIs should expose and what shouldn't be exposed" –Head of Risk for CTO

The Chief Technology Officer and Head of Risk for CTO were slightly concerned about the overall security and privacy requirements that are expected of a Bank from a customer and regulatory point of view; but they are convinced that it is not just a technology problem there are a various contributing factors such as people and processes. Trusting the ability of this technology to protect customer privacy depends on the appetite for risk.

"No, you got to have technology, processes, people, you got to have a lot other things watching this stuff to make sure you comfortable with it, technology is one important component but not the only one." –Chief Technology Officer

There seem to be dispute between technology executive, head of Risk and the lower level managers. The managers seem to think that the technology is capable of protecting customer privacy and have sufficient security controls in place. They certainly seem to be considering just a technology with no regards to the overall outlook. The lower level

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managers; when asked the similar question of whether they trust the ability of this technology to protect customer privacy they all seem to be in agreement.

"Yes" – integration developer at IBM API management

"Question is not necessary APIs but potentially what you want, example you want to implement an API that ask for customer data, obviously what you will need to do is to do two parts, one part is you need ensure that only the authorized party can access that API" – Enterprise Architect

"Yes it does, the technology had to go through architecture and Atticus redesign and had to go to information security approval so there was a big design approach that was followed to get this technology into the back" –line manager in API manager space**.**

The interviewees all agree that security and privacy can negatively affect the level of adoption of external Web APIs in a Bank**.**

"It most definitely does cause the Bank has obligation to its clients to make sure that any data is secured" –line manager in API manager space**.**

Theme 7: Trust

According to Zaman et al. (2013) the perceived trust construct in technology adoption seems to be a barrier. The interviewees expressed confidence in trusting API technology they all seem to agree that API technology can be trusted to a certain degree to be financially secure.

"I used them on a daily basis, to some degree I do. To some degree, you can't necessary say you trust web APIs per say, you got to say well am trusting these APIs from this part, maybe you trust the party that provides the API is actually more important" –enterprise architect.

"There's obviously certain level of trust, but they are business process in the Bank that needs to be followed to establish if this provider is somebody that you want to do

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business but I don't think trust is the only thing we consider" –line manager in API manager space.

The technology itself as a standalone tool can be trusted but when considering the business service and other factors that interact with the technology such as people and processes then trusting the technology becomes a multifaceted factor that requires thorough consideration prior reaching any conclusion. Majority of the interviewees seem to be concerned about the people and process side of trust and not the technology.

"How do you trust that the people that are using it are who they say they are" –Chief Technology Officer

"they is a lot of processes in the Bank that they have to follow to make sure that the third party that we are engaging with is a preferred provider" –line manager in API manager space

"regulation wise yes because from a Banking respective one of the things that Banks enforce on Global laws of money laundering and anti-terrorism legislation and things like that so we have to do our due diligences to make sure the customer is who they say they are" –Head of Risk for CTO

When interviewees were asked whether trust of API technology affects the adoption levels at Absa; they indicated that trust is a significant factor in the adoption of external Web APIs at a Bank.

"*Yes, you have too, if you don't trust the technology, you are going to place reliance on it. So trust in the technology terms is multi-faceted, trust in technology is can you rely on output of the technology that's one part of trust another part of trust is can you rely on its availability and another part is can you rely on it's none repudiation so absolutely."* – Head of Risk for CTO

Trust was interpreted as a multifaceted attribute that affects the levels of adoption of external Web APIs at Absa Bank.

"For sure, they will be certain things that we can do even though we can do it today but won't do it today because we can't protect it to that level so we won't open it up, it has a big effect" –Chief Technology Officer

"Yes, you have too" –Head of Risk for CTO

The six themes related to the research questions were consistent amongst interviewees except for a few cases where the levels of seniority might have prevented other respondents to have the same answer. There were other themes that are not related to the research questions such as business processes. Other themes will be used in the proposed best practises.

5.3   Quantitative Data Analysis

The survey questionnaire consisted of 28 items that belong to 7 different parts of the quantitative study. The context of the quantitative study is re-established by making reference to the overall research design in Figure 12 below.
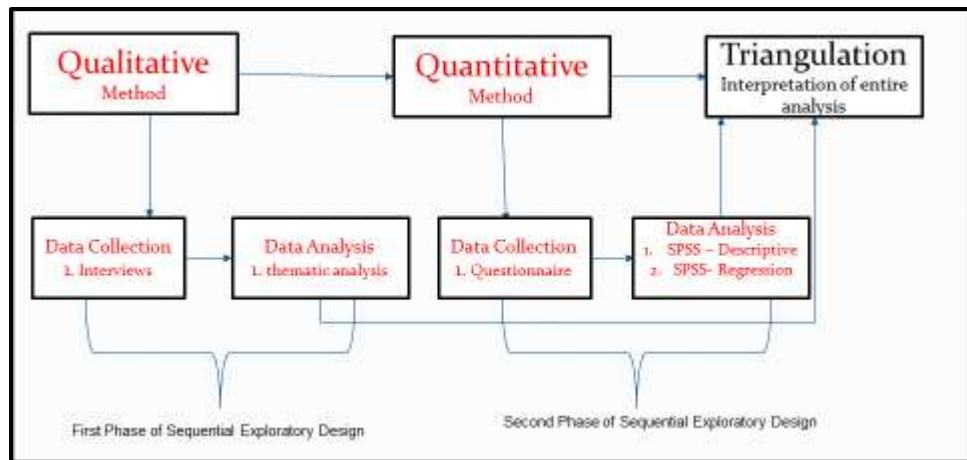
Figure 12: Phase Two of Sequential Exploratory Design

The inception of quantitative analysis involved coding the quantitative instrument responses into SPSS. Some items were reverse coded (for validation of the instrument) in order to ensure that all responses were analysed as positive indicators of the concept under investigation.

Many of the constructs from the DOI theory were operationalised via more than a single question. In order to obtain a holistic perspective on each construct, the individual items responses were reduced to a single value by computing an average response. This method is aligned to the suggestion in Sekaran and Bougie (2013) that multiple responses that measure a single construct may be reduced to a single value by computing a mean value.

In order to present a succinct representation of the variables in the study, Table 12 is used to show the independent and the dependant variables that form the main units of analysis.

Table 12: Study Variables together with the coded values

Independent	Dependent
Perceived Relative Advantage (**RA**)	
Perceived Compatibility (**CO**)	
Perceived Complexity (**CX**)	
Perceived Trialability (**TR**)	Willingness to Adopt Web API (**WTS**)
Perceived Observation (**OB**)	
Perceived Trust(**PT**)	
Perceived Security & Privacy (**PSP**)	

In order to ascertain the inter-item reliability of the questionnaire responses, the Cronbach's Alpha analysis was conducted. As shown in Table 11, the internal validity is for all the main variables in the study are in excess of 0.7 which attests to a high level of internal validity (Gliem & Gliem, 2003).

Table 13: Reliability Analysis- Cronbach's Co-efficient alpha

Construct	Cronbach's Alpha
Perceived Relative Advantage(RA)	0.704
Perceived Compatibility(CO)	0.717
Perceived Complexity(CX)	0.738
Perceived Trialability(TR)	0.723
Perceived Observation(OB)	0.899
Perceived Trust(PT)	0.766
Perceived Security & Privacy(PSP)	0.943
Willingness to Adopt Attitude	0.732

Demographics

An indication of the capacity that each respondent served at Absa Bank is shown in Table 13. It should be noted that the objective of ensuring representation from the systems analysts as well as the developers is achieved. Twenty percent of the respondents served in both capacities thereby enabling a response that was informed from the dual perspectives of analysis and development.

Table 14: Participants Job Title

Capacity	No of Years	%
Systems Analyst	5	12.5
Analyst Dev	8	20.0
Developer	27	67.5
Total	40	100.0

Model Testing

The seven hypotheses were formulated to assist in answering the study questions and fulfil the study objective as best as possible. The hypotheses were tested through the association tests i.e. The Pearson's Correlations and Regression Analysis performed on the collected data through SPSS to investigate the influence of the independent variables on the dependent variable of the study. According to Al-Somali et al. (2009) Multiple Regression analysis can be used to test Rogers (2010) perceived innovation attributes and other factors such as perceived trust.

The sections below discuss the correlations and regression analysis of the independent variables and dependent variable to determine the influence of Roger's perceived attributes of innovation, trust and security on the willingness of adoption of external Web APIs at Absa Bank.

Correlations

A Pearson correlation analysis was conducted to test the presence of a relationship between the independent and dependent variables in the study. This exercise was also undertaken so as to test the hypotheses and ultimately answer the main research questions. Table 13 shows the Pearson correlation co-efficient value between the dependent variable (WTA – willingness to adopt) and the independent variables of the study. From an overview perspective, the inter-connectedness of the independent variables were removed from the data presentation because the main objective at this stage is to establish presence and strength of the relationship between the dependent variable and the independent variables of the study.

Table 15: Correlation of Predictor Variables and the Dependent Variable

	RA	CO	CX	TR	OB	PT	PSP	WTA
RA	1							0.906**
CO		1						0.903**

CX			1					0.663**
TR				1				0.840**
OB					1			0.887**
PT						1		-0.022*
PSP							1	-0.032*
WTA								1

N=40, **. Correlation is significant at the 0.01 level (2-tailed).
*, Correlation is significant at the 0.05 level (2-tailed).

The correlation co-efficient and the significance of the relationship between each of the independent variables and the dependent variable is discussed below:

- The correlation analysis indicates that Relative Advantage (RA) of external Web APIs is positively and significantly associated with willingness to adopt external Web APIs (WTA) (0.643**, p<0.01). This observation provides evidence to reject null hypothesis H_{N1} that there is no relationship between RA and WTA Web APIs.

- The correlation analysis indicates that Compatibility (CO) of external Web APIs is moderately positive and significantly associated with willingness to adopt external Web APIs (WTA) (0.462**, p<0.01). This observation provides evidence to reject null hypothesis H_{N2} there is no relationship between CO and WTA Web APIs suggesting that Web APIs is compatible with the existing knowledge and experience of employees as well as the IT infrastructure at Absa Bank.

- The correlation analysis indicates that Complexity (CX) of external Web APIs is strongly positive and significantly associated with willingness to adopt external Web APIs (WTA) (0.728**, p<0.01). This observation provides evidence to reject null hypothesis H_{N3} that there is no relationship between CX and WTA Web

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APIs. The message emanating from this correlation is that the use of Web APIs at Absa Bank does not incur much overhead with regards to complexity of use.

- The correlation analysis indicates that Trialability (TR) of external Web APIs is moderately positive and significantly associated with willingness to adopt external Web APIs (WTA) (0.660^{**}, $p<0.01$). This observation provides evidence to reject null hypothesis H_N4 that there is no relationship between TR and WTA Web APIs suggesting that Web APIs may be used on a trial basis before adoption without incurring the consumption of too many resources at Absa Bank.

- The correlation analysis indicates that Observability (OB) of external Web APIs is moderately positive and significantly associated with willingness to adopt external Web APIs (WTA) (0.553^{**}, $p<0.01$). This outcome provides evidence to reject null hypothesis H_N5 that there is no relationship between OB and WTA suggesting that the benefits of using Web APIs are quite tangible and the employees at Absa Bank are sensitive to its potential to deliver value.

- The correlation analysis indicates that there is a weak negative relationship between Perceived Trust (PT) of external Web APIs and the willingness to adopt external Web APIs (WTA) (-0.022^{**}, $p<0.01$). This observation provides evidence to reject null hypothesis H_N 6. The data analysis suggest that the relationship is not positive and has slight leanings towards being a negative relationship. The indication is that the employees at Absa Bank do not have trust in the use of Web APIs at Absa Bank. This outcome will be explored further during the qualitative data analysis.

- The correlation analysis indicates there is a weak negative relationship between the security inherent in the use of an external Web API and willingness to adopt external Web APIs (WTA) (-0.032^{**}, $p<0.02$). This observation provides evidence to reject null hypotheses H_N7. The data analysis suggests that a relationship exist and has slight leanings towards being a negative relationship.

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The indication is that the employees at Absa Bank are of the opinion that the Web APIs do not meet the security standards of banking applications. This outcome will be explored further during the qualitative data analysis.

From correlation analysis conducted it can be revealed that all of the DOI constructs are positively correlated with the willingness to adopt Web API technology at Absa Bank. However, there is a weak negative relationship between the added constructs of Perceived Trust and Security of Web APIs. From an analysis perspective, the results in Table are sufficient to address the hypotheses that were proposed at the outset of the current study.

5.4   Summary of the Chapter

Chapter five carried out phase 2 of the sequential exploratory design. The first phase involved analysis of qualitative data through thematic analysis in six steps. Thematic analysis elicited themes that were used for the final analysis of qualitative data. The second phase of sequential exploratory design focused on quantitative analysis using SPSS tool to perfume correlations and multiple regression between the predictor variables and the willingness to adopt external Web APIs which is used to test the hypotheses of the study.

CHAPTER 6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

The conclusion section will focus on discussion and triangulation of finding from qualitative and quantitative analysis. The findings will be based on qualitative findings and using quantitative results to validate qualitative findings. This chapter will also address the hypotheses defined in chapter one as the means to answer the research questions. Chapter six will also present the proposed best practise for implement Web APIs.

6.2 Discussion of Research Questions

The interviews were able to collect information about the case project being studied to answer the main questions of the study. The project of Web APIs, in particular external Web APIs, of Absa Bank South Africa is fairly new, established in April 2016 by the Chief Technology Officer. The interview with the API Manager Team leader revealed that the API project uses the IBM tool called API Manager, which was soon to be updated to API Connect. The initial phase of the project included an exhaustive analysis of other similar vendor tools but it was concluded that an API Manager from IBM will be a good choice.

The compatibility of this tool played a major role in that decision. According to the API Manger team leader, Absa Bank already uses a number of core Banking IBM tools such as 'Data Power' which plays a significant role in the API Economy project of Absa Bank. Other IBM tools which were necessary for the success of API Manager were already in place, making the IBM API Manager a compatible technology to use at Absa Bank.

The correlation analysis from the quantitative component of the study shows that the perceived compatibility of external Web API's significantly influences the external Web API adoption at Absa Bank. This conclusion was also supported by Interviewee 4, who an API team leader at Absa Bank. Based on the questionnaires findings, complexity

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observability, and trialability are all significant influencers of adoption of external web APIs by Absa Bank.

The interviewees showed a willingness to adopt external Web APIs with regards to *relative advantage* associated with external Web API value. The respondents were leaning towards technical, financial, operational and strategic values. Quantitative analysis supported this view with a strongly positive correlation between relative advantage and willingness to adopt external Web APIs. The outcome from the surveys (quantitative) and the interviews (qualitative) converged to the conclusion that Web API technology will be beneficial for adopters in the banking sector. The analysis performed indicated a strong positive correlation between Web API adoption and relative advantage. The interviews revealed that the competitive advantage factor was obtained not just through the implementation of Web API technology but also via the services that this technology exposed through its open interface. The open interface facility ensured that the clients were able to leverage ease of use and accessibility to enhance the competitive advantage over other banks.

The perceived trust, privacy and security of external Web APIs in relation to the willingness to adopt external Web APIs by Absa Bank was examined through thematic analysis of interviews. These interviews revealed that trust is multifaceted. Trust is not necessarily a technology-oriented problem. One of the interviewees who is a senior manager and an academic (holds a PhD in Information Systems) points out that trust does influence the willingness to adopt external APIs but not from a technology perspective, but more so from a business perspective. External Web APIs do not necessarily conform to regulations in the banking sector or regulations with Absa itself and these APIs need to be modified to meet these standards. These modification exercises may eventually degenerate into a substantive process itself, thereby negating any advantage of using the Web API in the first place. It is for this reason that many development teams simply resort to using local modules that they have more control over. This sentiment is endorsed by the Chief Technology Officer (CTO) at Absa Bank.

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According to questionnaire analysis there is a negative and moderate association between the security inherent in the use of an external Web API and willingness to adopt external Web APIs. The findings reject the null hypotheses **H$_{N6}$**. We can conclude that according to developers of APIs at Absa Bank the willingness to adopt external web APIs is moderately and negatively influenced by the perceived security of external Web APIs. The aforementioned is also supported by the data collected through interviews. The interviewees indicated concerns with the use of external Web APIs with regards to security in the banking sector. The issue of security has always been a major stumbling when it comes to banking applications and the adoption of 3rd party solutions such as external Web APIs.

From an interpretivist perspective, the issue of trust presented itself as more of a pivotal phenomenon than security. A significant message that emanated with regards to trust is that it is a concept that is multi-faceted. It is not just technology, but also the processes and people as well as the norms and values (culture) that need to be upheld at Absa Bank and the use of external Web APIs may compromise this. In terms of banking regulations, the Bank is required to know all sources of transactions that are conducted. This cannot be attributed to the influence of a 3rd party because in such a case, the Bank is held liable. The functionality that the APIs expose to different sets of developers needs to be controlled and monitored. This adds an entire new layer of management that needs to be tied into the organizational structure of the Bank. Hence, the issue of trust opens up too much complexity in terms of how it could be mitigated. So the reluctance of banking personnel to accept external Web APIs on the basis of trust and security is fully understandable.

The outcome of these deliberations is that the alternate hypotheses 1 to 5 which focused more on the benefits of using a new technology (innovation) from a functional perspective have all been upheld. However, the non-functional issues related to trust and security (H_{A6} and H_{A7}) indicates that Web API technology cannot be accepted because of the business issues that take precedence over the technology aspect of this innovation.

6.3　Proposed Best Practices

One of the main objectives of this research project was to propose a set of best practices for implementing an external web API in a banking setting based on the knowledge obtained from the Absa Bank case study. The proposed best practices of external Web APIs implementation is intended to guide, support, escalate and improve the likelihood of Web APIs being adopted. However, it should be noted that the model does not guarantee that the issue of trust and security will be resolved. However, it provides an opportunity for these aspects of Web API implementation in the banking sector to be better controlled and managed.

The best practices model is presented in the form of a Web API lifecycle model illustrated in Figure 13. The main constructs from the model have been identified from the thematic analysis that was conducted during the interview phase of the study. A significant aspect of the themes that were identified is that there was substantial talk of the use of a DevOps strategy where the application development teams works in an integrated manner with the operations teams so that new applications may be **designed**, **built**, **tested** and **deployed** in a quick cycle. In this way there is a possibility that issues of trust and security may be addressed because the applications will have a high level of visibility enabling extensive testing before deployment. These is still no guarantee of absolute security and trust, but the prospect of compromise is minimised. The cycle proposed in Figure 13 resonates well with an agile approach that ensures quick delivery and continuous integration with existing systems.
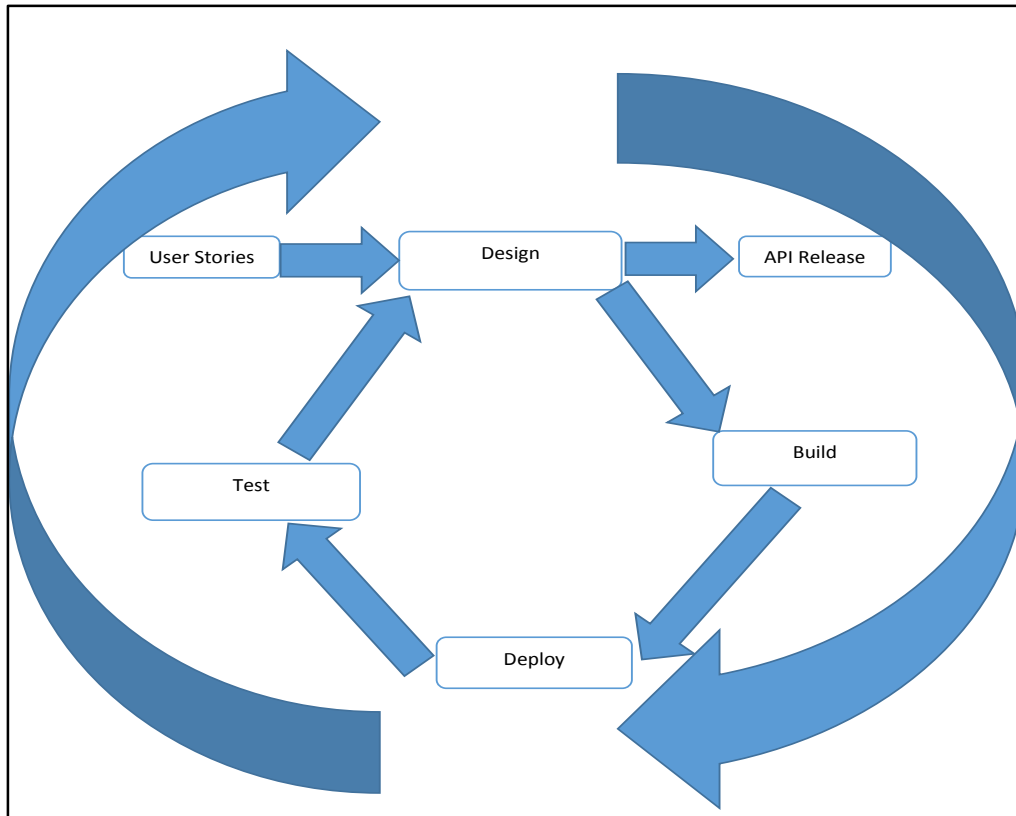
Figure 13: Proposed best practices life cycle

The verbatim transcripts that were pivotal in the development of the Web API lifecycle model proposed in Figure 13 is documented in the subsequent text. The core components of the model proposed in Figure 13 is discussed below.

1. Web API development life cycle (Figure 13) :

   DevOps – methodology that brings together application development and operations. When respondents were asked about Web API compatibility in terms of complimenting the current Absa software engineering values such as Agile and DevOps, the response was that Web API usage should be aligned to the DevOps approach for software development.

"current software practices enable you to run the web API service properly not just a case of doing it; not having those disciplines (proper practice for Web API) means that the service is not running properly" -Head of Risk

- Integration of DevOps and iterative Agile Methods onto a Web API development life cycle.

  According to Zhu, Bass, and Champlin-Scharff (2016) "DevOps is a set of practices intended to reduce the time between committing a change to a system and the change being placed into normal production, while ensuring high quality". In practice DevOps comprises of tools and strategies that enable a culture of collaboration, continuous integration and ownership. Continuous integration is achieved through the automation of software development activities. The integration of DevOps and Scrum methodology into the life cycle of Web APIs development (Figure 13) will streamline the currently fragmented process of agile development, DevOps and Web API implementation.

2. Developing User stories –

   According to Lucassen, Dalpiaz, van der Werf, and Brinkkemper (2015) are of the opinion that User Stories are an ideal strategy to document user requirements especially in an agile development environment. The main reasons for this phenomenon are:

   - Ease of use

     User stories should be based on the 'ease of use' principle as the interviewees mentioned the significance of simple Web API. A simple Web API should have one specific function.

     "Ease of use all of that is pretty important to be successful." –CTO
     "A well-designed and architected API should deal with a single concern"
     –Enterprise Architect.

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- Data mapping for API consumer and provider.

  Precise definition of data coming and going out as this should be used to determine if the business service should be exposed to enforcing customer privacy which is a barrier to adoption according to interviewees.

  "Protecting our customers is a barrier it's what we here for as a Bank." – CTO

3. Design

   - Ease of use

     Well documented API specification will allow for code reuse which was indicated by interviewees as the driver of Web API's adoption. Well documented specification will also promote the Bank's Web APIs to the outside world which will be financially beneficial to the Bank and drive up the levels of adoption within and outside the Bank.

     "Strategically it is extremely high in the strategy to use APIs and services not only from inside the Bank to allow quick and easy reuse and connectivity but also allow many applications and other levels of Technology as well as other people to connect to the Bank and use the Bank services and make it very easy for them to do it and through that I will enable other people to innovate and use their thoughts but using our platform to bring more revenue to us" –CTO

4. Build and deployment.

   - Continuous integration – making use of DevOps tools such as Github, Bitbacket and GitLab can allow for easy management of configurations and continuous integrations. According to L. Yu, Mishra, and Mishra (2014) "GitHub is a distributed code repository and project hosting web site". Bitbacket and GitLab are alternatives to Github. DevOps tools can also help with the offline code version management since most API

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managers including IBM API manager currently being used by Absa do not provide a built in tool for code management which is crucial for easy maintenance of a Web API.

"API Manager is currently being used, and they is a lot of limitation around API management from a DevOps perspective. So they is lot of processes in place, they is lot of stumbling blocks for our consumers to actually say that I've got a solution and I want to get it into ABSA Bank" –
API Manager team leader

5. Testing and Release

- Complete automation- according to Bozkurt et al. (2010) testing Web APIs requires more than conversional testing strategies. Testing can be automated by a various testing tools such as Apeche JMeter and DevOps tools such as Jenkins can be used to for a comprehensive automated testing for all possible pitfalls of the service. According to Ebert, Gallardo, Hernantes, and Serrano (2016) Jenkins is java based open source server for automation. This tool can be used to identify issues immediately after testing. The automated testing approach can help remedy the issue of testing data faced by the API Manager team. According to interviewees from this team the testing data is barrier for them since they are an independent team not connected to the businesses offering the service. DevOps tools will give ownership to the service development who have access to the required testing data. According to Virmani (2015) DevOps approach can bridge between continuous integration and continuous releases.

"The most difficult part about testing is data, obtaining data that is required for you to make that test" – Integration developer at IBM API management

"testing it is a bit of a challenge because we can only test the API from a functionality perspective so if you press a button does it work but we cannot get in or because we don't know the business area as well because you don't have proper test data" –API Manager team leader

The aforementioned best practices are based on the themes elicited from interview transcripts using thematic analysis. The practices aim to address some of the barriers to adopting using expert's opinions from the interviews and information systems literature. The emphasis is the DevOps tools and practices. DevOps does not only create software release patterns but it also automates the steps from software design, development, testing, creating images and deployment. The automation if best applied can solve a number of barriers identified from interview's transcripts such as testing data. Integrating DevOps approach can assist in populating test data and triggering testing suites on the images (Virmani, 2015).

6.4   Limitations and Future Research

The limitations of the study were only discovered during data collection and after. The role business plays in technology decision making within a bank cannot be overlooked and there was only a minimal reference to the business context during the empirical phase of the study. The time was also a limitation for the researcher and respondents. The availability of targeted individuals for the interviews was at a premium, thereby constraining the richness of the data that was obtained. There was also the issue of a lack

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of funding for the transcription the interview recordings. Interviews were transcribed manually, resulting in a delay of the analysis.

An exploratory study is required to root out all the factors associated with technology adoption in the banking sector. The current theoretical models such as the Diffusion of Innovation theory are not adequate to explain the adoption of a software engineering methodology such as Web APIs. The inclusion of variables oriented along the dimensions of trust and security needs to be incorporated into technology adoption theory.

6.5   Conclusion of the Study

The objective of the study was to determine the level of adoption of external Web APIs at Absa Bank. The study was operationalised by variables that were contextualised via the main research questions. The first research question was aimed at establishing the level of adoption of Web APIs by focusing the inquiry on the attributes Web Aps. This question was decomposed into 5 sub questions with each question being aligned to Rogers (2010) perceived attributes of innovation. The Roger's Diffusion of Innovation theory argues that the five attributes explain a higher variance in the adoption of technological innovations. A significant outcome of this, the quantitative phase of the study, is that the respondents indicated a strong intention to adopt Web API technology at Absa Bank. The Pearson Correlation performed on quantitative data supported these findings. However, on further inquiry, it was established that the construct of trust, which is not part of Roger's DOI theory, did not display the same level of intention to adopt as did the traditional construct of innovation diffusion theory. This outcome was corroborated by the qualitative phase of the study which consisted of interviews with key technology stakeholders at Absa Bank

The qualitative phase of the study consisted of interviews. Thematic analysis was used to analyse the audio transcripts. A number of themes were elicited using thematic analysis. The findings of the study were based on those themes. Web API value and trust were amongst the dominant themes. The interviewees believed that trust is a multifaceted attribute. The trust attribute ended up being the most interesting as the result of the

environment a Bank operates in. The lack of trust in the ability of this technology to protect customer privacy and sensitive financial data of the Bank and customers negatively influences the adoption of external Web APIs at Absa Bank. These other two factors require more attention and response strategies in order to increase the willingness to adopt external Web APIs at Absa Bank.

The final phase of the study entailed the development of a 'best practices model' for API implementation. The best practises were developed based on the themes that were identified during the qualitative data collection and analysis. The model was developed by integrating aspects of DevOps and iterative agile methodology into a Web API framework. The objective of the proposed model was to alleviate problem areas in the adoption of Web APIs and leverage Design, Build, Deploy and Test phases into an integrated framework. Such a framework would enhance the acceptability of Web APIs because of its alignment to the DevOps and Agile methodologies.

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UKZN HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE (HSSREC)

**APPLICATION FOR ETHICS APPROVAL
For research with human participants**

Information Sheet and Consent to Participate in Research

Date:

Greetings,

My name is Ndlovu Thobekani (Student No. 208502893) and I am currently studying for a Master of Commerce (MCMC) degree at the University of KwaZulu-Natal (UKZN), in the School of Management, Information Technology and Governance. The discipline of my study is in Information Technology (IT). The contact details for myself as well as my supervisor and the academic department at UKZN are listed below:

Researcher Name: Ndlovu Thobekani; e-mail: Thobekani.Ndlovu@absa.co.za ; Work Contact Number: 0829377363
Mobile Contact Number: 0815812298
Supervisor Name: Mr S Ranjeeth; e-mail: ranjeeths@ukzn.ac.za ;
Office contact Number: +27 33 260 5641
Department of Information Systems & Technology: +27 33 260 5704; + 27 31 260 7051

You are being invited to consider participating in a study that involves research on the adoption of External Web APIs. The title of my study is: Factors Influencing the Adoption Rate of External Web API's: An Examination of the Uptake of the External Web API's by Absa Bank: *A Case study of Absa Bank South Africa*

The aim and purpose of this study is to examine the contextual characteristics of External Web APIs/ Services, as well as perceived Privacy & Security, and Trust to predict and improve the likelihood of its

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adoption. This aspect of the study will entail the conducting of interviews with key stakeholders who are in a position to provide information and make decisions on behalf of the Bank regarding adoption of External Web APIs/ Service at Absa Bank. The interviews will be used as a platform to obtain an understanding of contextual and situational attributes of External Web APIs/ Services that may be barriers to adoption. This study has the main objective of proposing an implementation framework guide to support and improve External Web APIs/ services likelihood of adoption by Absa Bank. The duration of your participation if you choose to participate and remain in the study is expected to be approximately 40 minutes.

We hope that the study will be beneficial to Absa's journey to service oriented architecture. It is also envisaged that the outcome of the study will make an academic and practitioner-based contribution to the general discourse on Web APIs/ Services.

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number_____).

In the event of any problems or concerns/questions you may contact the researcher by making use of any of the contact details provided above, or by contacting the UKZN Humanities & Social Sciences Research Ethics Committee. The contact details are as follows:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION
Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban 4000 KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604557- Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

Your participation in the study is voluntary and by participating, you are granting the researcher permission to use your responses. You may refuse to participate

or withdraw from the study at any time with no negative consequence. There will be no monetary gain from participating in the study. Your anonymity will be maintained by the researcher and the School of Management, I.T. & Governance and your responses will not be used for any purposes outside of this study.

All data, both electronic and hard copy, will be securely stored during the study and archived for 5 years. After this time, all data will be destroyed.

If you have any questions or concerns about participating in the study, please contact me or my research supervisor at the numbers listed above.

Sincerely

Ndlovu Thobekani

CONSENT TO PARTICIPATE

I ……………………………………………………………………………………. (Name) have been informed about the study entitled Factors Influencing the Adoption Rate of External Web API's: An Examination of The Uptake of The External Web API's by Absa Bank South Africa *: A Case study of Absa Bank South Africa* by *Thobekani Ndlovu*.

I understand the purpose and procedures of the study.

I have been given an opportunity to ask questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any of the benefits that I usually am entitled to.

I have been informed about any available compensation or medical treatment if injury occurs to me as a result of study-related procedures.

If I have any further questions/concerns or queries related to the study I understand that I may contact the researcher at the details provided in **Page 1** of this document.

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

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I hereby provide consent to:

Audio-record my interview / focus group discussion   YES / NO
Video-record my interview / focus group discussion   YES / NO
Use of my photographs for research purposes   YES / NO

_____   _____
Signature of Participant   **Date**

_____   _____
Signature of Witness   **Date**

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(Where applicable)

_____   **_____**
Signature of Translator   Date
(Where applicable)

General Instructions for the Interview

During the interview, you are at liberty to request clarification or repetition of the question. There is no time limit set for answering a particular question or for the duration of the interview session. It is advisable to complete the interview in a single sitting.

Section A – Demographics & Background Information

- Please, state your name, title, age and position within the company.

- How many years have you been in this role for in the company?

- Please provide some details regarding your experience in the domain of software development.

- Please provide some details regarding your experience with Web APIs/ Services.

- Please provide some details regarding some of the Web APIs/ Services' projects that you have been involved with

Section B – Web APIs/ Services Contextual Attributes

This section seeks to establish whether the Rogers (2010) perceived innovation characteristics have an effect on adoption of External Web APIs/ Services by Absa Bank and how Absa Bank is responding to the effect..

RELATIVE ADVANTAGE (RA):

RA1: What would you consider as value in using External Web APIs/ Services?

RA1 follow up 1: does this have an influence on the decision to use External Web APIs/ Services?

RA2: Are External Web APIs/ Services a strategic solution?

COMPATIBILITY (C):

C1: Does external Web APIs/ Services practice compliment Absa Bank values and beliefs of software engineering/ good software development practice?

C2: Can External Web APIs/ Services be applied across the Bank technology divisions?

TRIALABILITY (T):

T1: Do Absa Bank provide a platform to publish/practice or demo External Web APIs/ Services?

T1 follow up 1: is this capability or platform open to all the developers?

T1 follow up 2: does this have an influence on the decision to use External Web APIs/ Services?

OBSERVABILITY (O):

O1: Do Absa Bank have a platform to showcase internal and external successful initiatives of External Web APIs/ Services to the rest of the Bank?

Does Web APIs provide ABSA with a competitive advantage over other Banks?

O1 follow up 1: does this have influence on the decision to use External Web APIs/ Services?

COMPLEXITY (CX):

CX1: Do you consider any of the following aspect of External Web APIs/ Services to be difficult?

    A) Web API/ Service design

    B) Access control

    C) Data transmission

    D) Testing

CX1 follow up 1: is it because of the Banking environment?

CX1 follow up 2: is it because of the internet environment?

Are there significant complexities associated with the use of external Web API technology?

How can these complexities be mitigated?

CX1 follow up 3: Do these complexities have an influence on ABSA's decision to use External Web APIs/ Services?

Section C – Web APIs/ Services perceived Trust, Privacy and Security

This section seeks to establish whether the trust, security and privacy have an effect on adoption of External Web APIs/ Services by Absa Bank and how is the Bank responding to the effect.

PERCEIVED TRUST (PT):

PT1: Do Absa Bank ensure third parties are likely to be reliable?

PT1 follow up 1: How? (Optional)

PT2: Would you say trust in this technology and third parties has an influence on the decision to use External Web APIs/ Service?

PERCEIVED SECURITY & PRIVACY (PSP):

PSP1: Do you consider using External Web APIs/ Services with third parties financially secure?

PSP1 follow up 1: does this have an influence on the decision to use External Web APIs/ Services?

PSP2: Does Absa Bank trust the ability of this technology to protect customer privacy?

PSP2 follow up 1: does this have influence on the decision to use External Web APIs/ Services?

Thank You for Your Participation

UKZN HUMANITIES AND SOCIAL SCIENCES RESEARCH ETHICS COMMITTEE (HSSREC)

APPLICATION FOR ETHICS APPROVAL
For research with human participants

Information Sheet and Consent to Participate in Research

Date:

Greetings,

My name is Ndlovu Thobekani (Student No. 208502893) and I am currently studying for a Master of Commerce (MCMC) degree at the University of KwaZulu-Natal (UKZN), in the School of Management, Information Technology and Governance. The discipline of my study is in Information Technology (IT). The contact details for myself as well as my supervisor and the academic department at UKZN are listed below:

Researcher Name: Ndlovu Thobekani; e-mail: Thobekani.Ndlovu@absa.co.za ; Work Contact Number: 0829377363
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You are being invited to consider participating in a study that involves research on the adoption of External Web APIs. The title of my study is: Factors Influencing the Adoption Rate of External Web API's: An Examination of The Uptake of The External Web API's by Absa Bank South Africa: *A Case study of Absa Bank South Africa*

The aim and purpose of this study is to examine the contextual characteristics of External Web APIs/ Services, and perceived privacy & Security, and Trust to predict and improve the likelihood of its adoption. The study will require participants to provide survey-based responses to questions regarding contextual attributes of External Web APIs/ Services as well as trust, and security & privacy. This study has the main objective of proposing an implementation framework guide to support and improve External Web APIs/ services likelihood of adoption by Absa Bank. The duration of your participation if you choose to participate and remain in the study is expected to be approximately 15 minutes.

We hope that the study will be beneficial to Absa's journey to service oriented architecture. It is also envisaged that the outcome of the study will make an academic and practitioner-based contribution to the general discourse on Web APIs/ Services.

This study has been ethically reviewed and approved by the UKZN Humanities and Social Sciences Research Ethics Committee (approval number_____).

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maintained by the researcher and the School of Management, I.T. & Governance and your responses will not be used for any purposes outside of this study.

All data, both electronic and hard copy, will be securely stored during the study and archived for 5 years. After this time, all data will be destroyed.

If you have any questions or concerns about participating in the study, please contact me or my research supervisor at the numbers listed above.

Sincerely

Ndlovu Thobekani

CONSENT TO PARTICIPATE

I ………………………………………………………………………………………. (Name) have been informed about the study entitled Factors Influencing the Adoption Rate of External Web API's: An Examination of The Uptake of The External Web API's by Absa Bank South Africa *: A Case study of Absa Bank South Africa* by *Thobekani Ndlovu.*

I understand the purpose and procedures of the study.

I have been given an opportunity to ask questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any of the benefits that I usually am entitled to.

I have been informed about any available compensation or medical treatment if injury occurs to me as a result of study-related procedures.

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I hereby provide consent to:

Audio-record my interview / focus group discussion   YES / NO
Video-record my interview / focus group discussion   YES / NO
Use of my photographs for research purposes   YES / NO

_____   _____
Signature of Participant   **Date**

_____   _____
Signature of Witness   **Date**
(Where applicable)

General Instructions

Please read and complete the following questionnaire. In those sections where options are provided, please indicate your response by making a cross (X) in the boxes provided.

Section A – Demographics & Background Information

Job Title/Position		
Department		
Gender	*MALE*	*FEMALE*
Age		
Years of Experience as a Software Developer		
Years of experience in using Web APIs/ Services		

Section B – Web APIs/ Services Contextual Attributes

This section seeks to establish whether the Rogers' perceived innovation characteristics have an effect on the adoption of External Web APIs/ Services by Absa Bank.

RELATIVE ADVANTAGE:	**Strongly agree**	**Agree**	**Neutral**	**disagree**	**strongly disagree**

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
External Web APIs/ Services improve my productivity when I use them.					
Mistakes with External Web APIs/ Services *are easier to correct* than traditional applications.					
Mistakes a*re more likely to occur* with External Web APIs/ Services than usage traditional applications.					
External Web APIs/ Services provide an advantage over traditional applications.					

COMPATIBILITY:	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
External Web APIs/ Services is compatible with the technological infrastructure that I work with					
External Web APIs reduce the amount of time it takes to develop software					
It takes a great effort for me to make use of external Web APIs					

TRIALABILITY:	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I am able to try out a Web API interface without being too concerned about the consequences of failure					
It did not take me much time to try external Web APIs before I finally accepted their use					
It is better to experiment with External Web APIs/ Services before adopting them.					

OBSERVABILITY:	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I was influenced by what I observed as the benefits of using External Web APIs/ Services.					
I observed others using External Web APIs/ Services and saw the advantages of doing so.					
There is no need to observe others using Web APIs before I make use of it..					

COMPLEXITY:	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
External Web APIs/ Services are difficult to understand and use.					
External Web APIs/ Services are convenient to use.					
I intend using Web APIs to enhance my job performance					
It is easy to use External Web APIs/ Services even if one has not used them before.					

Section C – Web APIs/ Services perceived Trust, Privacy and Security

This section seeks to establish whether the trust, security and privacy have an effect on adoption of External Web APIs/ Services by Absa Bank.

PERCEIVED TRUST:	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I believe that making use of third party External Web APIs/ Services is likely to be safe.					
My web service interaction with other External Web APIs/ Services is likely to be reliable.					

Many things may not go wrong with my interaction with other External Web APIs/ Services.					
I am confident that third party interaction with my web service will be transparent.					

PERCEIVED SECURITY & PRIVACY:	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I trust the ability of web service to protect our customer privacy					
Matters on security has no influence in using external Web APIs/ Services					
External Web APIs/ Services provide secure data transmission channels to secure all interactions between the third party and my web service					
Web service technology provides the latest security prevention technologies to prevent unauthorized access to External Web APIs/ Services					
Web service technology provides the latest security detection technologies to prevent unauthorized access to External Web APIs/ Services.					
Web service technology provides the latest security response technologies in cases of unauthorized access to External Web APIs/ Services					
I feel safe when I release information to third parties through External Web APIs/ Services					

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APPENDIX C: ETHICAL CLEARANCE

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KWAZULU-NATAL

INYUVESI
YAKWAZULU-NATALI

05 July 2017

Mr Thobekani Ndlovu (208502893)
School of Management, IT & Governance
Westville Campus

Dear Mr Ndlovu,

Protocol reference number: HSS/0835/017M
Project title: Factors influencing the Adoption Rate of External API's: An examination of the uptake of the External Web API's by ABSA Bank: A case study of ABSA Bank South Africa

Approval Notification – Expedited Application

In response to your application received on 19 June 2017, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment/modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

Dr Shenuka Singh (Chair)

/ms

Cc Supervisor: Mr Sanjay Ranjeeth
Cc Academic Leader Research: Professor Brian McArthur

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